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Managed by Rio Tinto Coal Australia

Coal & Allied Industries Limited

Lower Hunter Lands Project

Catherine Hill Bay (Middle Camp)

Traffic and Transport

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

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Author	Mukit Rahman and Alen Krljic	
Checker	Jim Dumont and Mukit Rahman	
Approver	Mukit Rahman	

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Final Report

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1 Introduction

1.1 Background

It is proposed that the entire Coal & Allied Industries Limited (Coal & Allied) owned Catherine Hill Bay (Middle Camp) site be rezoned/listed as a 'State Significant Site' (SSS) in Schedule 3 of State Environmental Planning Policy (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan for a residential subdivision of the Catherine Hill Bay (Middle Camp) site will apply to the entire 569 ha Catherine Hill Bay (Middle Camp) site. The key parameters for the future development of the site are as follows:

- Dedication of 526.58 ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising approximately 93% of the Catherine Hill Bay (Middle Camp) site.
- Dwelling yield of 222 dwellings (including 57 integrated housing dwellings) and 3 super dwellings over 28.2ha.
- Two developable areas are identified under the Concept Plan located to the north of the Middle Camp heritage township,:
- Developable area A (northeast) = 7.32ha;
- Developable area B (northwest) = 20.88ha.
- Indicative development staging. The number of dwellings and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces.
- The provision of associated infrastructure.
- Torrens title subdivision of the Catherine Hill Bay (Middle Camp) site. The Torrens title subdivision and boundary realignment of Coal & Allied land will enable the following:
    - Transfer of land 526.58 ha in area that is owned by Coal & Allied to be excised and to be dedicated to NSWG for conservation land.
    - Transfer of land 2.33 ha in area that is owned by Coal & Allied, located between the cemetery and the oval and including the adjacent car park, together with 0.73 ha south of the existing bowling club to Lake Macquarie City Council.
    - Enable land 12.38 ha in area that is owned by Coal & Allied comprising four houses north west of Northwood Road and land 0.17ha east of Flowers Drive, to be retained by Coal & Allied post transfer of the conservation land.

Approval will not be sought under the Concept Plan for a specific lot or road layout. An indicative lot layout will indicate how the dwelling yield of 222 dwellings could be achieved on the site. Similarly, approval will not

be sought under the Concept Plan for subdivision or construction of individual houses. However, the desired future character of the proposed concept plan will be included in Urban Design Guidelines. Urban Design Guidelines will be prepared to inform the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement (VPA) between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979 (EP&A Act).

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas is included in the Environmental Assessment (EA) prepared by Urbis.

1.2 Director General's Requirements

The Director-General's Requirements (DGRs) for the subject land were issued on the 19th of August 2010 and are summarised as follows:

(1) Prepare a Traffic Study in accordance with RTA's *Guide Traffic Generating Developments* that includes (but is not limited to) the following:

a) An identification of all relevant vehicular traffic routes and intersection for access to/from the area;
b) Current traffic counts for all of the above traffic routes and intersections;
c) The anticipated vehicular traffic generated from the proposed development and associated trip distribution on the road network;
d) Consideration of the traffic impact on the existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated;
e) An analysis of the cumulative traffic and transport impacts of the development taking into consideration other proposed developments;
f) Details of necessary road network infrastructure upgrades required to maintain existing levels of service both on the local and classified road network;
g) An intersection analysis, using SIDRA or similar traffic model, as well as a micro simulation model to determine the need for intersection and mid block capacity upgrades and to ensure traffic signal coordination;
h) Proposed pedestrian and cycleway access within and to the site that connects to all relevant transport services, nearby settlements, and other key off-site locations having regard to the *NSW Planning Guidelines for Walking and Cycling* (2004), and the *NSW Bike Plan* (2010);
i) Timing of delivery of proposed transport infrastructure including road and intersection upgrades, pedestrian and cycle paths, and public transport infrastructure; and
j) Consideration of impacts on existing property access.

(2) Assess the proposal against the objectives of the Integrating Land Use and Transport policy package.

Coal & Allied commissioned Hyder Consulting Pty Ltd (Hyder) to carry out the traffic study to address the DGRs and examine the traffic and transport issues associated with the Concept Plan for the subject site. Hyder met with the RTA on 17 September 2010 and discussed issues and traffic works in relation to the above DGRs'. Hyder has consulted the following state and local government planning policies and instruments that may apply for the subject site:

a) RTA's *Guide Traffic Generating Developments, 2002.*

b) *NSW Coastal Design Guidelines.* The Minister for Planning has issued a Direction under section 117 of the Environmental Planning and Assessment Act 1979 to all local councils in the coastal zone regarding the Coastal Design Guidelines 2003.

c) *Central Coast Regional Strategy*, NSW Department of Planning 2008. The Strategy represents an agreed NSW Government position on the future of the Central Coast. The Central Coast Regional Strategy applies to the period 2006-2031 and will be reviewed every five years.

d) *Lower Hunter Regional Strategy, NSW* Department of Planning 2006. The Lower Hunter Regional Strategy plans for approximately 160,000 additional people by 2031. Future additional residential development is planned for the Wyee, Nords Wharf, Gwandalan and parts of Catherine Hill Bay, which are in and to the north of Central Coast Region. The Lower Hunter will continue to provide jobs for residents of the Central Coast and vice versa. The Lower Hunter Regional Strategy applies to the period 2006-2031 and will be reviewed every five years.

e) The RTA and Lake Macquarie City Council's response to DGR's for the subject site issued in July 2010.

f) *The Integrating Land Use & Transport Planning Policy Package (ILUT),* NSW Department of Urban Affairs and Planning, 2002. The ILUT provides a framework for State Government agencies, councils and developers to integrate land use and transport planning at the regional and local levels. The ILUT is designed to increase access to services and improve the choice of transport available.

g) *NSW Planning Guidelines for Walking and Cycling,* NSW Government, 2004;

h) NSW Bike Plan, NSW Government 2010.

Hyder has prepared this traffic and transport report to respond to the key issues associated with the Catherine Hill Bay (Middle Camp) Concept Plan for the development of 222 residential dwellings.

1.3 Study area

The subject site covers the existing urban area along the Flowers Drive in Catherine Hill Bay. Figure 1-1 shows the study area in the context of site access and local road network. It is anticipated that potential traffic impacts from proposed residential development will impact two key intersections with the Pacific Highway including Pacific Highway with Flowers Drive intersection to the north and Pacific Highway with Montefiore Street intersection to the south.

1.4 Study objectives

The purpose of the traffic study is to assess existing traffic patterns, undertake traffic projections for the study area and to conduct an evaluation of the traffic implications of the proposed Catherine Hill Bay development on the road network. Key specific purposes were to:

- Address the Director-General's Requirements (DGRs) specifically for Traffic and Transport;
- Assess the overall impact of the proposed residential development on the road network considering current traffic counts at all relevant vehicular traffic routes and intersections;
- Identify key access points for the proposed development considering the existing constraints and opportunities from the perspective of both traffic and road safety;
- Determine the capacity of key intersections providing access & egress for the proposed development;
- Predict and assess the additional traffic generated from the proposed development, based on RTA's Guide to Traffic Generating Developments (2002); and
- Assess the cumulative traffic impact of the proposed development at Catherine Hill Bay considering potential development of the Rose Group zoned sites and the traffic impact in the absence of the development of the Rose Group sites.

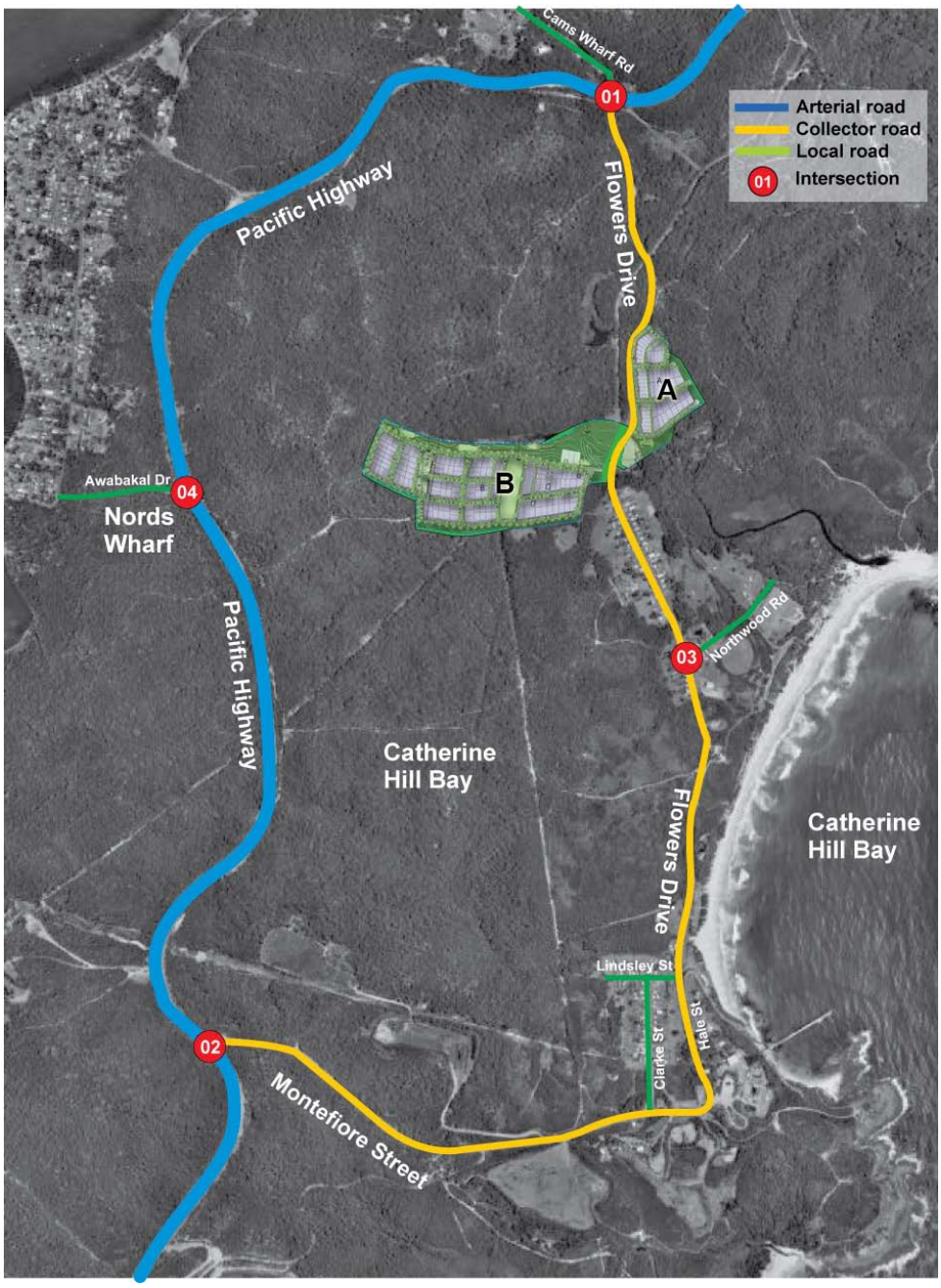


Figure 1-1 Study area network showing Coal & Allied Catherine Hill Bay (Middle Camp) development

1.5 Approach to traffic investigation

This traffic report was prepared to examine the impact on the road network from the 222 dwellings proposed at the Catherine Hill Bay (Middle Camp) site. Cumulative impact was assessed based on the potential lot yield on the Rose Group zoned sites and Coal & Allied developments at Catherine Hill Bay, Middle Camp, Nords Wharf and Gwandalan. In assessing the traffic impact from the proposed 222 dwellings, Hyder considered the broader traffic assumptions, impact on road network and the implications of the traffic generation on the Pacific Highway intersections performances

based on the cumulative impact. Hyder evaluated the traffic impact in the following areas:

- Additional development trips from 222 dwellings;
- Future forecasts on internal and external network particularly impact on Flowers Drive through Middle Camp;
- Model assumptions and scenarios;
- Impact on regional road network and intersection operation (Scenario S1);
- Impact of traffic from the Coal & Allied Catherine Hill Bay (Middle Camp) site. This is documented as Scenario S2;
- Cumulative traffic impact. This is documented as Scenario S3;
- Impact of holiday traffic;
- Concept plan assessment; and
- Management and mitigation.

Table 1-1 summarises the key development which are assumed in the traffic assessment.

Table 1-1 Key development assumptions

		Concept Plan/Zoned Land
Developers	**Sites**	**No of dwellings**
Coal & Allied	Middle Camp	222
Coal & Allied	Gwandalan	415 residential dwellings +208 dwellings (retirement village)+2800m^2 GFA of retail
Coal & Allied	Nords Wharf	90
Rose Group	Catherine Hill Bay	Potential yield of 600 residential dwellings
Rose Group	Gwandalan	Potential yield of 187 residential dwellings
Totals		**1,722**

The following points are noted from Table 1-1:

- Residential development of 222 dwellings at Middle Camp
- Full development at the Coal & Allied Middle Camp site could occur by 2012. In the instance of delays to the Middle Camp development; the study has assessed the cumulative traffic impact at key intersections with the Pacific Highway up to year 2018.
- Assumptions in association with the potential development of the Rose Group zoned sites; and
- Cumulative impact was assessed from 1,722 dwellings including potential Rose Group zoned sites.

1.6 Report Structure

This report has the following structure:

- Section 1: Introduction- background of the study area, traffic study process and objectives of this study.
- Section 2: Key transport indicators- provide a review of the road network, land use, journey to work data, public transport network and usage, road hierarchy and traffic data service and results
- Section 3: Impact assessment- describes the impacts on regional and local road network from the proposed development at Catherine Hill Bay (Middle Camp).
- Section 4: Summary of Findings.

2 Key transport indicators

2.1 Road hierarchy and network

The RTA Road Design Guide defines the functional road hierarchy in urban areas to establish a consistent basis for traffic management. There are four levels of roads and their functions are stated below:

- Arterial roads – predominantly carry through traffic from one region to another, forming principal avenues of communication for urban traffic movements;
- Sub Arterial Roads – connect the arterial road to areas of development and carry traffic directly from one part of a region to another. They may also relieve traffic on arterial roads in some circumstances;
- Collector Roads – connect the sub-arterial roads to the local road system in developed areas; and
- Local Roads – are the sub-divisional roads within a particular developed area. These are used solely as local access roads.

The key roads that provide access to the proposed Catherine Hill Bay development site are summarised in Table 2-1. .

Table 2-1 Road hierarchy in and around subject site

Road Names	Road Hierarchy	Characteristics
Pacific Highway	Arterial	The Pacific Highway is the main arterial route in the vicinity of the subject area, providing access to Newcastle to the north, and connection to the Sydney-Newcastle Freeway (F3) to the south. Near the site, the Pacific Highway is a four-lane divided highway. It has a sign posted speed limit of 100 km/h.
Flowers Drive	Collector	Flowers Drive is the northern access road for Catherine Hill Bay with direct access to the Pacific Highway, and thereby Swansea and Newcastle to the north. Flowers Drive connects with Cams Wharf Road at the Pacific Highway. It is a four-way intersection, controlled by "Stop" signs. Acceleration and deceleration lanes are provided on the Highway to facilitate traffic turning into Flowers Drive and Cams Wharf Road. Flowers Drive is a two lane, undivided road without line marking or paved shoulders. Kerbs and gutters are only provided at residential frontages. The sign posted speed limit of 60km/h at the intersection with the Pacific Highway, increases to 80 km/h at 300m to the south of the Pacific Highway, then decreases to 50km/h through the Catherine Hill Bay township.
Montefiore Street	Collector	Montefiore Street is the southern collector road to/from the Pacific Highway. Through its painted seagull intersection at the Pacific Highway, it provides residents' access to the Central Coast to the south. Acceleration and deceleration lanes are provided on the Highway to facilitate traffic turning into and out of the Montefiore Street. After the closure of the Moonee Colliery site, a number of gates that were used for mining access remained open at Montefiore Street. Although Montefiore Street is a private road, local residents use the road to access the Pacific Highway.
Northwood Road	Local	Northwood Road is a local street connecting the Flowers Drive to areas on its east side. It provides access to the Catherine Hill Bay Oval, Cemetery and beach. There is no sign posted speed limit on Northwood Road; however, the general 50km/h urban speed limit should apply. Currently, there is no line marking on the Northwood Road.

2.1.1 Key Intersections

Key intersections related to the Coal & Allied Middle Camp development are listed in Table 2-2. The proposed development in the Catherine Hill Bay area is likely to be governed by the future spare capacity available at these intersections.

Table 2-2 Key Intersections

ID	Intersection	Control Type and Characteristics
I-1	Pacific Highway/Flowers Drive/Cams Wharf Road	Four way stop sign controlled intersection
I-2	Pacific Highway/Montefiore Street	T-junction (Give-way) intersection with painted seagull arrangement

2.2 Demographic

The Census 2006 data indicates that Catherine Hill Bay has a population of 153 persons. Survey indicates about 112 houses in the entire Catherine Hill Bay community. The community is poorly serviced in terms of commercial and retail facilities. There is one pub and Bowling Club. There are no schools, medical facilities or convenience shops. The closest shopping centre is at Swansea.

Catherine Hill Bay forms a small part of travel zone (TZ 3353, see Figure 2-1) defined by the Census Journey to Work 2006. This travel zone also constitutes work trip information for Nords Wharf and Cams Wharf areas. The Journey to Work data indicates about 94 percent work trips were made by private car followed by 3 percent by bus. Walking, cycling and other forms of travel accounted for about 3 percent of all work trips. The Journey to Work data showed that about 15% of people did not travel (or unstated trips) on the Census day. The unstated trips are not included in the mode share estimation as stated above.

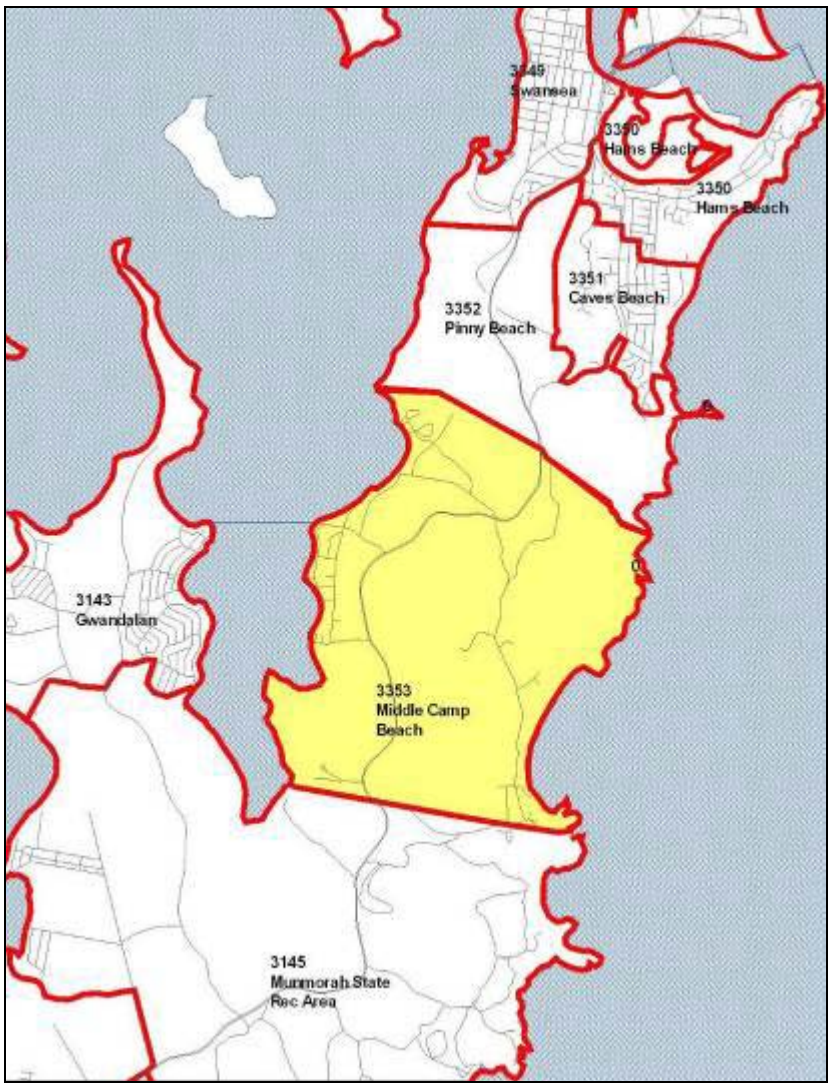


Figure 2-1 Travel zone boundaries, 2006 Bureau of Transport Statistics

2.3 Public transport network and use

2.3.1 Bus services

Figure 2-2 shows the existing bus route map serving Catherine Hill Bay. The subject site is serviced directly by Busways Route 99 which runs from Lakehaven Shopping Centre and Swansea. It calls at Gwandalan, Nords Wharf and Catherine Hill Bay. However not all localities are visited by all services. At present there are five services to Catherine Hill Bay in each direction on weekdays and two services on weekends. The services generally commence after 09:00 and end before 16:00 and are therefore more suited for shopping or school children than for commuting. Route 99 travels along Flowers Drive and provides the public transport access opportunity to the subject site.

The operator of Busways was contacted regarding upgrades to the service. Busways advised that bus services were continually under review and that more frequent services would be considered as additional residential development occurs in Catherine Hill Bay, Gwandalan and Nords Wharf.

Figure 2-2 Busways existing bus route map serving Catherine Hill Bay, Gwandalan and Nords Wharf (*source:www.131500.com.au)*

2.3.2 Rail services

The nearest rail station to Catherine Hill Bay is approximately 24 km away at Wyee, on the Newcastle and Central Coast line. Commuters wanting to use the rail service would need to drive or cycle to the station. From Wyee passengers can travel to Gosford or Wyong on the Central Coast, Sydney, or Newcastle. Train services are provided over 24 hours and at weekends. Weekday day time/commuter services are shown in Table 2-3.

Table 2-3 Train Frequency

Time Period	Trains Wyee to Newcastle	Trains Wyee to Central
06:00-09:00	6	5
09:00-16:00	7	7
16:00-19:00	7	6

2.4 Pedestrian and cyclist network

In Catherine Hill Bay, all local streets are designated as shared cycling and pedestrian usage. The Pacific Highway can also be used for cycling routes.

2.5 Parking

Currently no parking restrictions are in place on either side of Flowers Drive, Montefiore Street and Northwood Road.

2.6 Historical traffic growth

Historical traffic data on the Pacific Highway was obtained from the RTA Hunter Region. Table 2-4 shows recorded traffic volumes from 1995 to 2010 on the Pacific Highway, approximately seven kilometres north of Awabakal Drive, Nords Wharf (RTA station number 05.002), Swansea. Annual traffic growth rates on the Pacific Highway over the last 15 years are summarised in Table 2-5.

Table 2-4 Historical traffic data (AADT) on Pacific Highway

		Year of Counts									
Station	**Road**	**1995**	**1998**	**2001**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009***	**2010***
05.002	Pacific Highway (5 km north of Flowers Drive)	13,346	13,948	14,771	15,732	15,472	15,130	15,458	15,647	15,644	16,193

*Note: 2009 and 2010 volumes are provisional Average Daily Traffic (ADT) provided by the RTA (data sample is smaller than one complete year).

Table 2-5 Annual traffic growth rates

Road	RTA Count station	Annual Average Growth			
		Between 1995-2001	Between 2001-2006	Between 2007-2010	average for 15 years 1995-2010
Pacific Highway (5 km north of Flowers Drive)	05.002	▲ 1.7 %	▲ 0.4 %	▲ 1.6 %	▲ 1.3 %

The following observations are noted from historical traffic data presented in Tables 2-4 and 2-5.

- Between 1995 and 2001 traffic on the Pacific Highway has grown from 13,300 to 14,700, an annual growth rate of 1.7% per annum.
- The growth rate reduced significantly between 2001 and 2006 to only 0.4% per annum. In fact, traffic reduced between 2005/2006 compared to 2004 data.
- Between 2007 and 2010 traffic growth on the Pacific Highway was 1.6% per annum;
- On average, in the last 15 years, between 1995 and 2010, traffic growth was 1.3% per annum;

- A conservative estimate of 2% per annum for background traffic growth on the Pacific Highway was assumed as a future proof for intersection modelling.

2.7 Crash data analysis

This assessment is based on the crash data supplied by the RTA for six years period from October 2004 to June 2010 including the provisional data. Crash data between November 2009 and June 2010 is provisional.

Crash data between 2004 and 2010 indicates that the majority of crashes, about 146, occurred on the Pacific Highway from Mine Camp Road to Chain Valley Bay Road (see Table 2-6, below). Of that total, three fatal crashes were recorded on the Pacific Highway. During the same period, seven crashes were recorded on Flowers Drive between Lindsley Street and Pacific Highway.

Table 2-6 Summary of the crash data for the period from 10/2004 to 6/2010

Location	Total Number of Crashes	Fatal Crashes	Injury Crashes	Non Injury Crashes	Casualties		
					Killed	Injured	Total
Pacific Highway from Mine Camp Road to Chain Valley Bay Road	146 (100%)	3 (2.1 %)	54 (37 %)	89 (61 %)	3	80	83
Flowers Drive	7 (100%)	0 (0%)	4 (57.2%)	3 (42.8%)	0	5	5

Note: Crash occurred at intersections are also included in the Table 2-6.

Figure 2-3 and Figure 2-4 show the number of crashes by crash type that occurred on Pacific Highway and Flowers Drive respectively. The data on Pacific Highway showed that “off road on curve (hit object)” crashes dominated with 92 crashes (63 percent) on the Pacific Highway. No pedestrians were involved in any crashes.

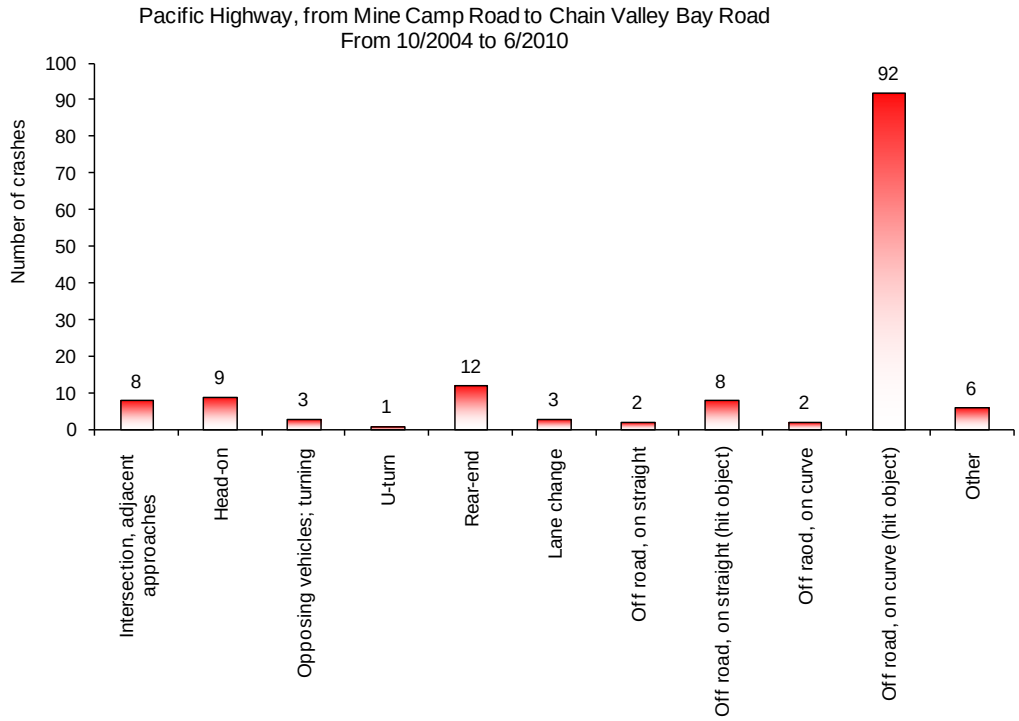


Figure 2-3 Pacific Highway-Number of crashes per crash movement (10/2004-6/2010)

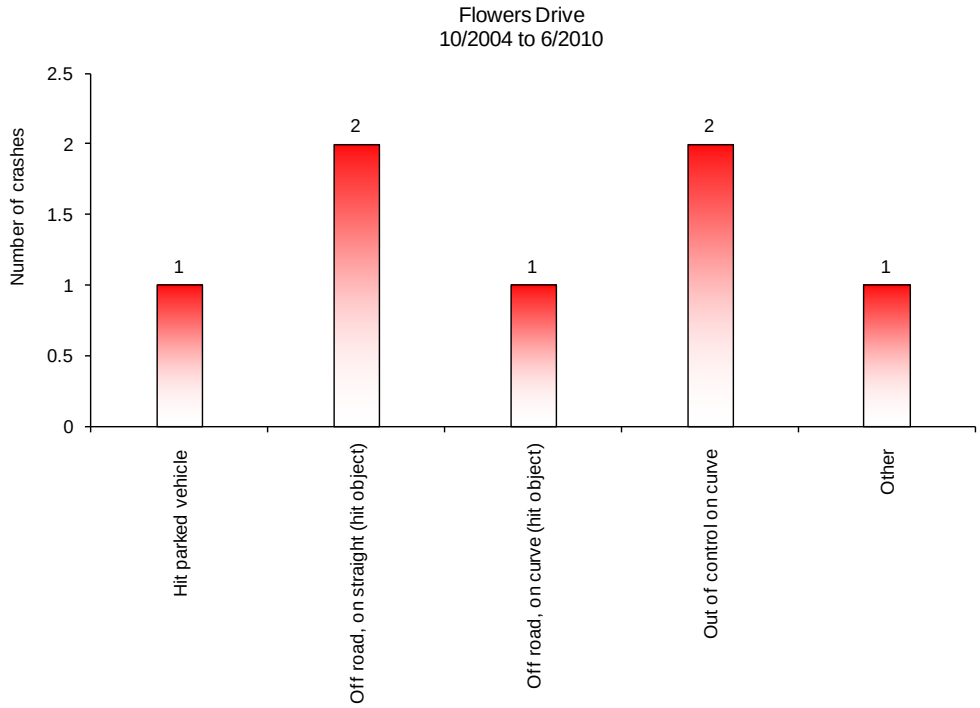


Figure 2-4 Flowers Drive-Number of crashes per crash movement (10/2004-6/2010)

Figure 2-5 and Figure 2-6 show crash locations visually along the Pacific Highway and Flowers Drive respectively. Crash data on Pacific Highway and Flowers Drive show that, in general, crashes occurred along the full length but are more concentrated on the curve sections of Pacific Highway, Flowers Drive and other traffic conflicting areas, for instance at intersections. The additional traffic generated by the proposed development at Catherine Hill Bay (Middle Camp) is unlikely to have any significant impact on the current crash rate or severity of crashes on the Pacific Highway and Flowers Drive in the vicinity of the proposed Middle Camp development.

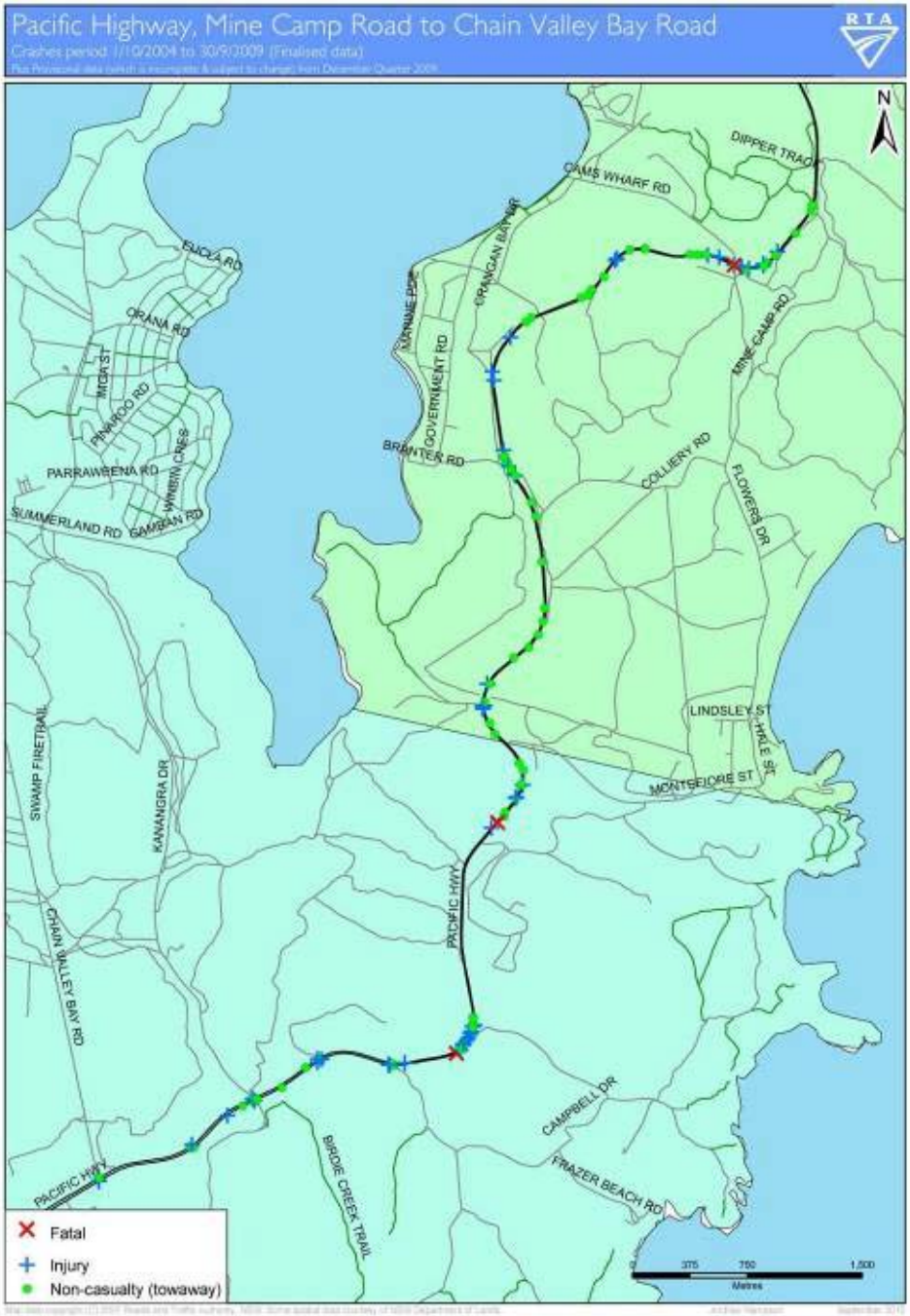


Figure 2-5 Pacific Highway, spatial distribution of crashes (10/2004 to 6/2010)

Figure 2-6 Flowers Drive, spatial distribution of crashes (10/2004 to 6/20100

2.8 Traffic data

Coal & Allied previously commissioned traffic count for all key roads and intersections for the Southern Estates. These counts were undertaken in July 2007. Between 2007 and 2010 there was no significant change in the land use in and around the study area. Between 2007 and 2010, local traffic movements (in/out) at Flowers Drive, Montefiore Street, Nords Wharf Road, Awabakal Drive and Kanangra Drive are unlikely to have changed. With RTA's concurrence, 2007 traffic counts have been used to update traffic volumes to year 2010. Extrapolation of the 2007 traffic data was undertaken using the historical traffic growth on the Pacific Highway. Traffic volumes for year 2010 were extrapolated from 2007 using a 2 percent growth per annum. It is expected that daily traffic profile, hourly traffic profile and proportion of heavy vehicles derived from 2007 counts will maintain similar traffic patterns in year 2010.

In the following sections, the estimated 2010 traffic volumes on the Pacific Highway are noted, where appropriate.

In 2007, for this study area, the following traffic surveys were carried out:

- Mid-block tube counts for periods of at least a week; and
- Intersection turning movement counts during morning and afternoon peak periods.

Four sites were selected for mid-block traffic counts as follows (see Table 2-7):

Table 2-7 Mid-block traffic survey locations

ID	Location	Survey Period
M-1	Flowers Drive, south of Pacific Highway	From 17July 2007 to 23July 2007
M-2	Montefiore Street, east of Pacific Highway	From 17July 2007 to 23July 2007
M-3	Northwood Road, east of Flowers Drive	From 17July 2007 to 23July 2007
M-4	Pacific Highway, south of Awabakal Drive	From 17July 2007 to 23July 2007

From this count data all vehicles were then classified into the twelve Austroads standard vehicle classes. Similar to midblock counts, three locations were selected for peak period intersection counts as follows (see Table 2-8):

Table 2-8 Intersection survey locations

ID	Location	Survey Period
I-1	Pacific Highway/Flowers Drive	Friday, 20 July 2007
I-2	Pacific Highway/Montefiore Street	Friday, 20 July 2007
I-3	Flowers Drive/Northwood Road	Friday, 20 July 2007

The intersection surveys were fully classified turning counts, conducted for both AM (7am to 10am) and PM (3pm to 6pm) peaks on Friday 20 July 2007 being the critical day found from other survey locations in this corridor. The following sections provide a summary of traffic results based on counts undertaken in 2007.

2.8.1 Average weekday and weekend traffic

Daily traffic volumes for the key roads were calculated (see Table 2-9 below) for an 'average weekday' and an 'average weekend' traffic. These two variations of traffic volume are derived from the mid-block surveys conducted during a 'typical' week, i.e. not during school holidays.

Table 2-9 Daily traffic volumes on key roads

Site ID	Road sections	Average Weekday 2007 (Counts)	Average Weekend 2007 (Counts)	Traffic Changes (Weekend)
M-2	Pacific Hwy, south of Awabakal Dr	13,800	11,000	-20%
M-1	Flowers Dr, south of Pacific Hwy	700	900	+29%
M-3	Montefiore St, east of Pacific Hwy	500	700	+40%
M-4	Northwood Rd, east of Flowers Dr	100	300	+200%

Below points are noted from Table 2-9 traffic results:

- During 2007, Pacific Highway carried approximately 13,800 vehicles per day during a weekday.
- In 2010, traffic volume on Pacific Highway is estimated at approximately 14,600 vehicles per day. This represents about an 800 vehicle increase in three years. This increase is unlikely to change traffic performance which was determined from 2007 counts.
- Weekend traffic is about 20% lower than weekday traffic. The data suggests Pacific Highway in this section carries high commuter demand between Central Coast and Newcastle;

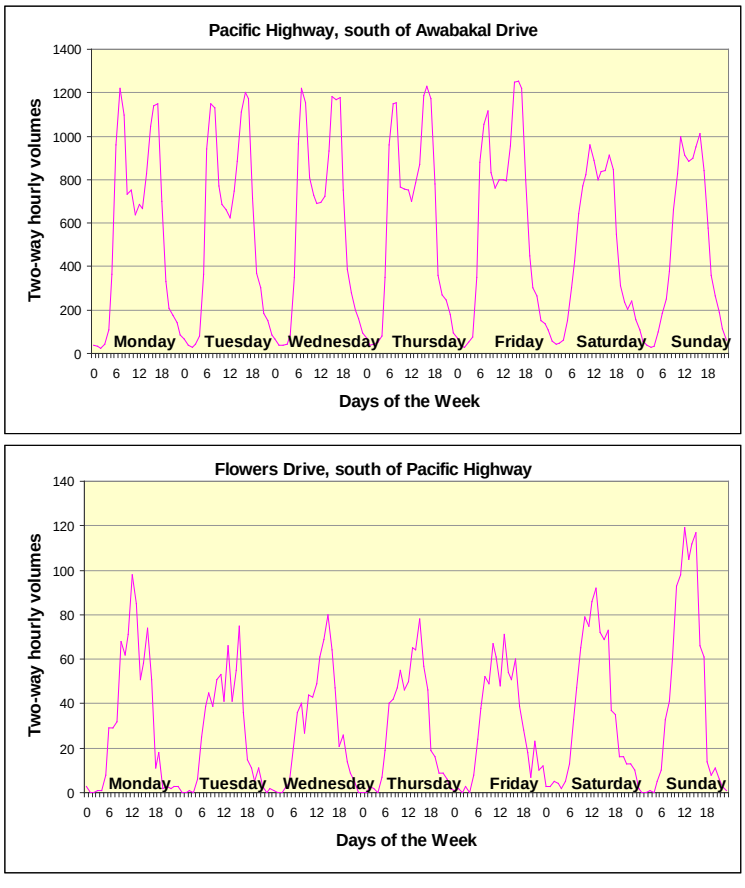
- Weekday traffic on this section is about 10% lower than annual average daily traffic (AADT) on the Pacific Highway near Swansea (see Table 2-4 for AADT data);
- As a collector road standard Flowers Drive and Montefiore Street, carry approximately 700 and 500 vehicles per day respectively. Weekend traffic on both roads is 30% and 40% higher than weekday traffic;
- Weekend traffic on Northwood Road is higher than weekday traffic as this road is used to access the nearby beach, cemetery and oval. Average weekday traffic on this road is about 100 vehicles increased to 300 vehicles during weekend.

2.8.2 Daily traffic profiles

Figure 2-7 shows the variations of traffic profile over one week period.

Key findings from Figure 2-7 indicate that:

- Traffic on surveyed roads is not constant but varies from day to day;
- Between Monday and Thursday traffic on the Pacific Highway is relatively constant, with a peak on Friday;
- Flowers Drive, being a collector road, exhibits similar traffic levels between Tuesday and Thursday. As expected, weekend traffic is higher than weekday traffic being contributed to by beach traffic;
- Montefiore Street and Northwood Road follow similar trend to Flowers Drive.



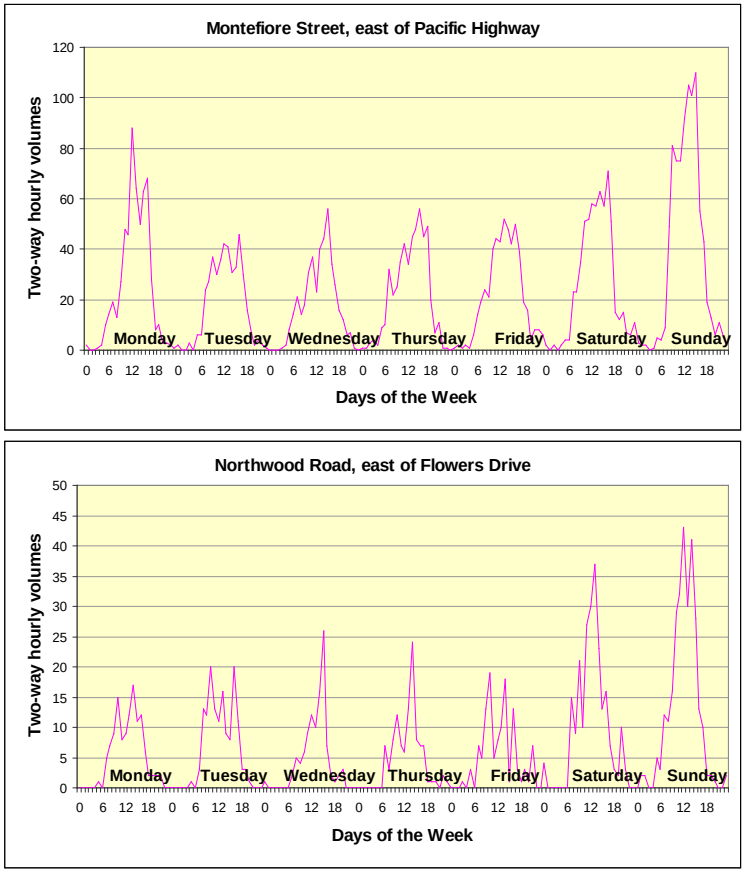
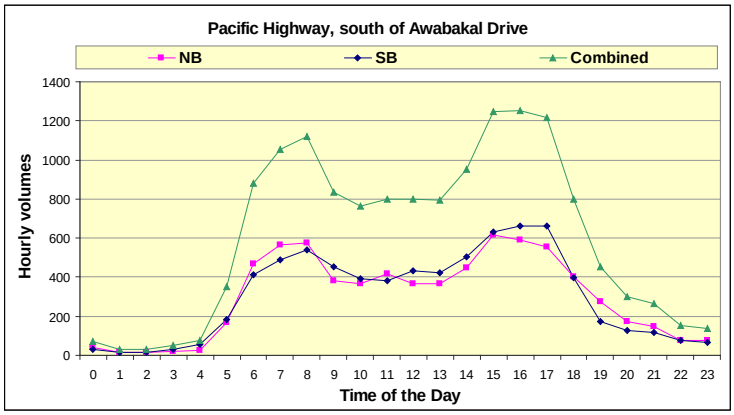


Figure 2-7 Daily variation of traffic volumes on key roads (Mid-block sites: M-2, M-1, M-3 and M-4)

2.8.3 Hourly variations

Figure 2-8 shows the hourly traffic volumes on weekday by direction of travel.

It was found that morning traffic reached its highest point between 8 am and 9 am on Pacific Highway and that the afternoon peak occurred between 3 pm and 4 pm. Flowers Drive and Montefiore Street showed peak during business hours between 12 and 2 pm.



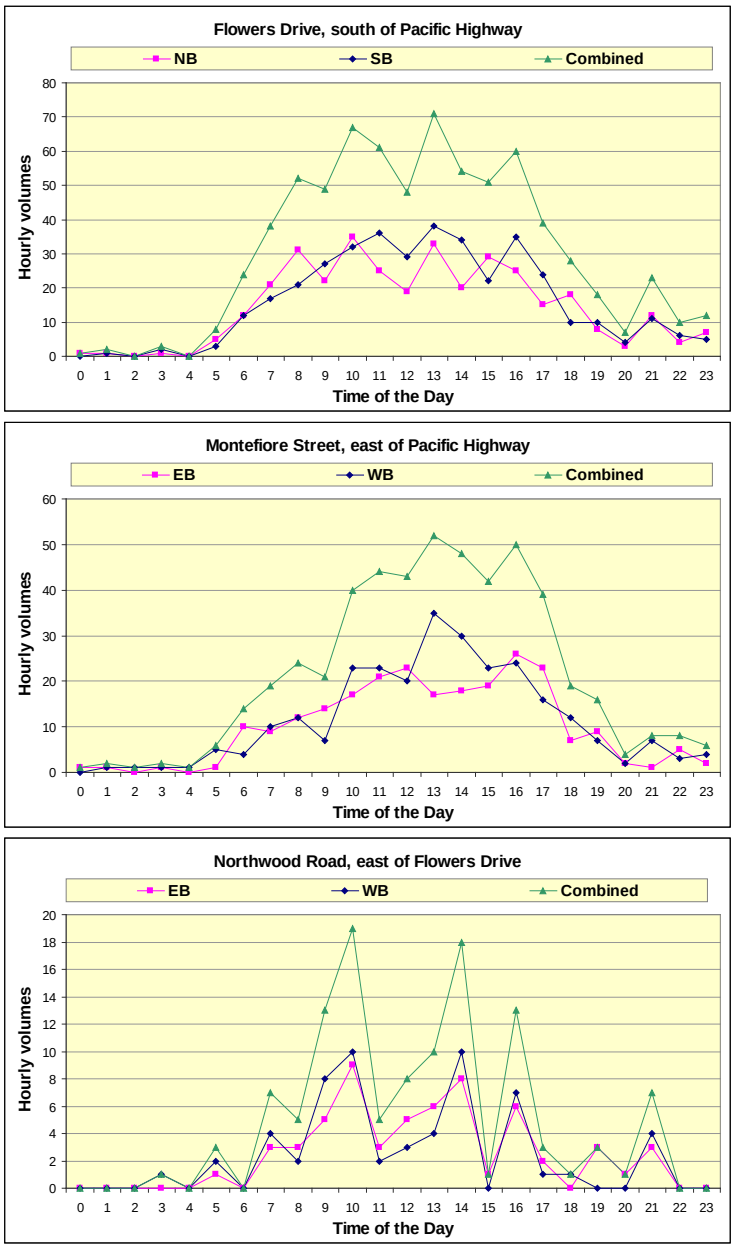


Figure 2-8 Hourly traffic variation at key roads

Table 2-10 summarised traffic data for Friday for both AM and PM peak hour.

Table 2-10 AM and PM peak hour volumes on key roads (Friday)

Site ID	Road sections	2007 (counts)					
		AM Peak (8 to 9am)			PM Peak (3 to 4pm)		
		NB/EB	SB/WB	Total (2-way)	NB/EB	SB/WB	Total (2-way)
M-2	Pacific Hwy, south of Awabakal Dr	580	540	1,120	620	630	1,250
M-1	Flowers Dr, south of Pacific Hwy	30	20	50	30	20	50
M-3	Montefiore St, east of Pacific Hwy	10	10	20	20	20	40
M-4	Northwood Rd, east of Flowers Dr	5	10	15	5	5	10

Data from Table 2-10 shows that:

- During 2007, peak hour traffic on the Pacific Highway was between 1,120 and 1,250 vehicles per hour.
- In 2010, traffic volume on Pacific Highway is estimated at approximately 1,190 to 1,330 vehicles per hour during AM and PM peak periods respectively. In hourly terms, this represents about a 70 to 80 vehicle increase in three years. This increase is unlikely to change traffic performance which was determined from 2007 counts.

- The notional capacity of a 4 lane Pacific Highway can be 5,000 vehicles per hour assuming 1,250 vehicles per hour per lane. This suggests Pacific Highway at this location has spare capacity for further growth;
- As a collector road standard, Flowers Drive and Montefiore Street carried about 50 vehicles per hour, significantly lower than environmental capacity (300 vehicles per hour) set by the RTA;
- Northwood Road also carries very low peak traffic volumes less than 10 vehicles per hour.

2.8.4 Heavy vehicles

According to AUSTROADS vehicle classification system, heavy vehicles include trucks with two or more axles, buses, semi-trailers and B-doubles (classification categories 3-12). Table 2-11 below shows the number of heavy vehicles recorded during the morning (8:00 am – 9:00 am) and afternoon (3:00 pm – 4:00 pm) peak hours and over the entire day. The numbers in parentheses contain the percentage of heavy vehicles of the total volume on that road.

Table 2-11 Heavy vehicles (2-way) on key roads (Friday)

		2007 (Counts)		
Site ID	Road sections	AM Peak	PM Peak	Daily
M-2	Pacific Hwy, south of Awabakal Dr	100 (9%)	90 (8%)	1,200 (8%)
M-1	Flowers Dr, south of Pacific Hwy	5 (10%)	4 (8%)	52 (7%)
M-3	Montefiore St, east of Pacific Hwy	3 (13%)	4 (10%)	47 (9%)
M-4	Northwood Rd, east of Flowers Dr	3 (60%)	0 (0%)	13 (11%)

The heavy vehicle data showed the following patterns:

- The heavy vehicle data recorded in 2007 showed that the Pacific Highway carried about 1,200 heavy vehicles per day;
- On Pacific Highway, the heavy vehicle proportion was about 8% to 9% of total traffic. This trend is consistent with the heavy vehicle proportion on other state roads (between 8% and 12 %).
- The number of heavy vehicles on Montefiore Street was about 47 vehicles per day. On Flowers Drive about 52 heavy vehicles were recorded.

2.8.5 Intersection turning volumes

Intersection turning movement data was a key input to the intersection capacity analysis. The turning movement data at intersection provided traffic distribution at the local level.

Figure 2-9 presents surveyed 2007 turning movements at three key intersections for both AM (8:00-9:00) and PM (15:00-16:00). Turning movement data were recorded during Friday peak travel condition.

Figure 2-10 presents estimated 2010 turning movements at the same intersections for both AM (8:00-9:00) and PM (15:00-16:00).

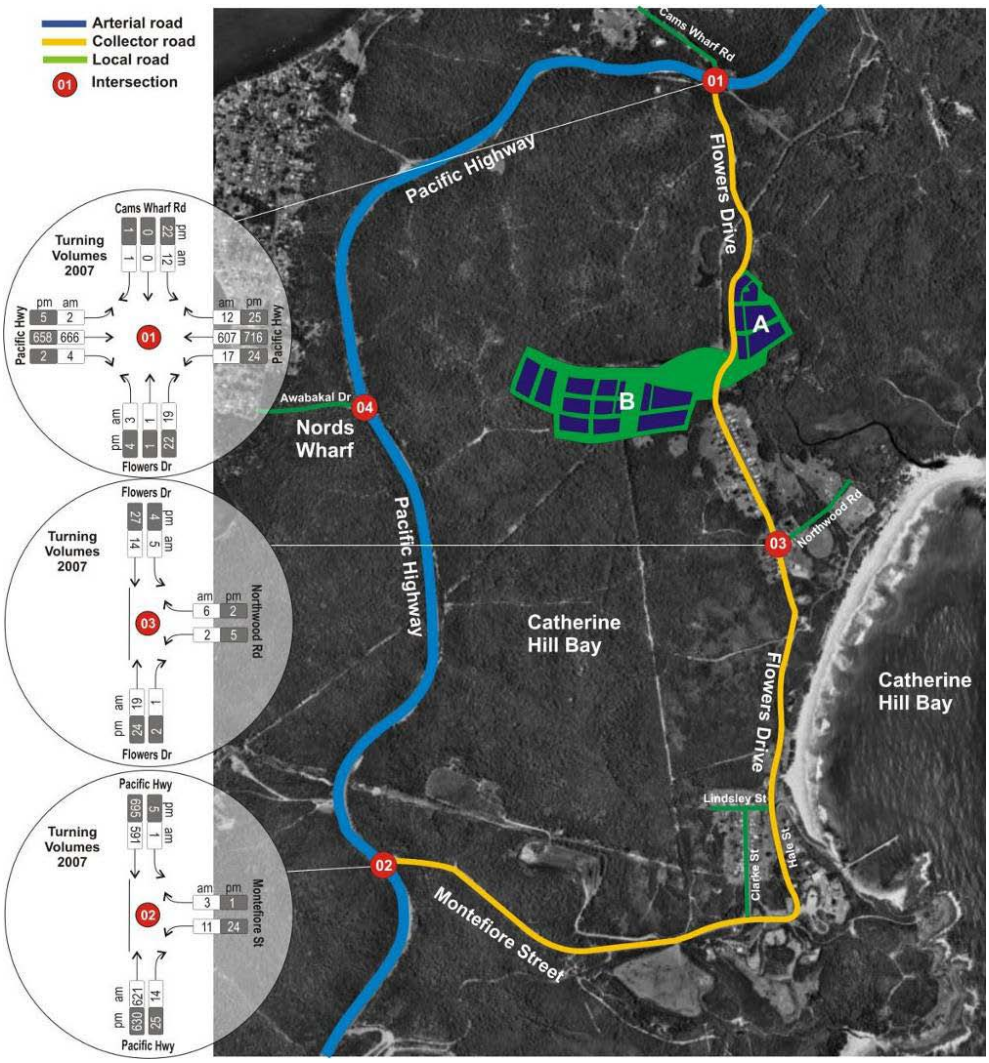


Figure 2-9 Intersection turning volumes for the AM and PM peak hours in 2007

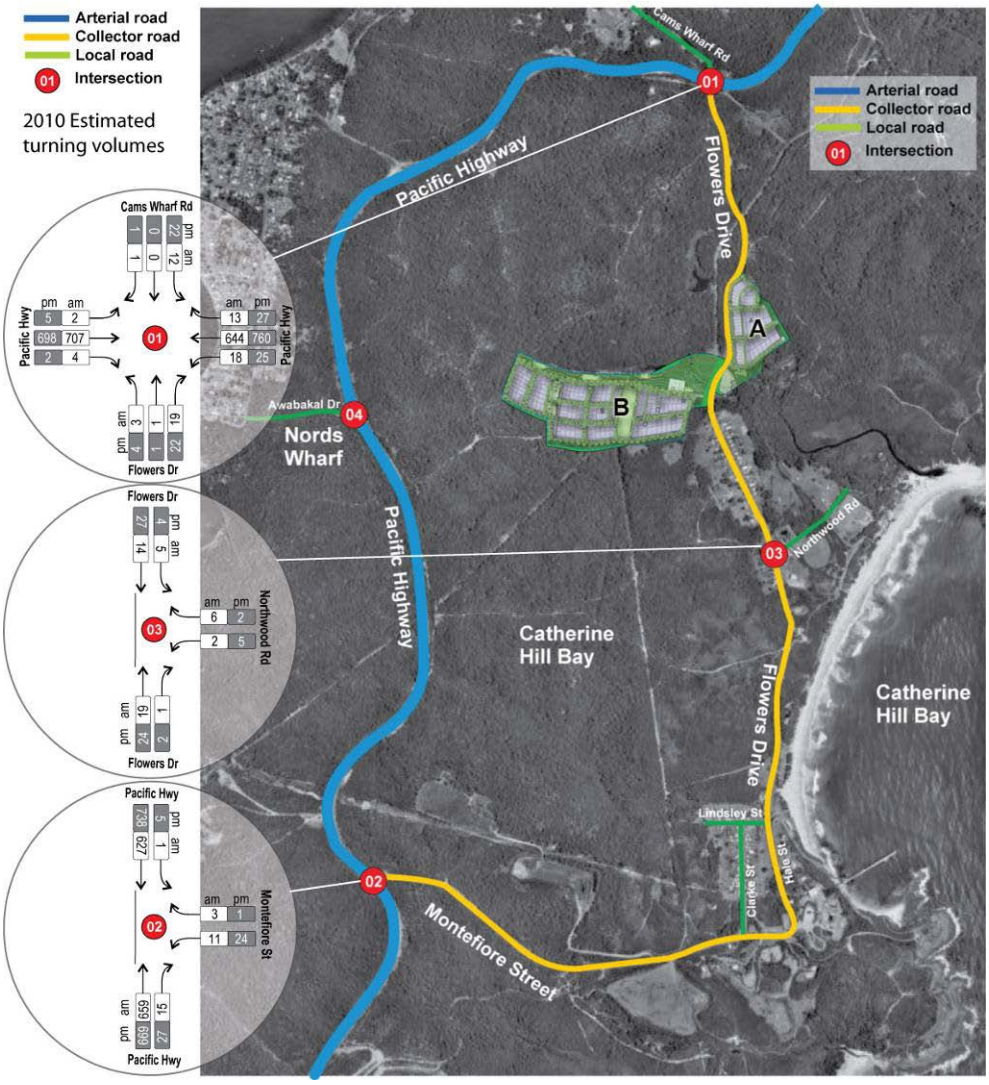


Figure 2-10 2010 Estimated Intersection turning volumes for the AM and PM peak hour

2.9 Road network capacity

Hyder used SIDRA traffic modelling software for assessing intersection performance. As per the DGR's, the need for a micro-simulation (Paramics) model for the subject site was discussed with the RTA. With RTA's concurrence, micro-simulation model (Paramics) was not required. SIDRA modelling was adequate for the subject site.

Assessment criteria of intersection

The standard intersection analysis program is SIDRA, which analyses the performance of single intersections and can thus determine the impact of a number of development options. For the assessment of this development's traffic impact, the four accepted measures of performance have been considered, which are:

- Level of Service (LoS);
- Degree of Saturation;
- Average Delay; and

- Maximum Queue Length.

These four measures are discussed below.

Level of Service (LoS)

This is a measure of the delay a vehicle suffers in negotiating an intersection. LoS applies to the intersection as a whole and to individual turning movements. Ratings of LoS A to C are in the acceptable range, with E and F considered unacceptable. LoS D may be acceptable in certain circumstances. The standard NSW Level of Service criteria for intersections are summarised in Table 2.12.

Table 2-12 LoS Criteria for intersection capacity analysis

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: RTA Guide to Traffic Generating Developments

Degree of Saturation (DoS)

This is the ratio of traffic flow for a particular vehicle movement to the capacity flow for that movement. The highest DoS is the DoS for the intersection.

Average Delay

The average delay is a simple calculation to find the difference between the travel times of vehicles delayed by traffic, compared to the travel time expected if there were no interruptions to the flow through an intersection. This is usually presented as seconds per vehicle.

Maximum Queue Length

Queue length figures used in this assessment are usually calculated as the '95th percentile back of queue.' This is the measure which 95% of all queues are within.

2.9.1 Existing intersection performance

The Pacific Highway/Flowers Drive, Pacific Highway/Montefiore Street and Flowers Drive/Northwood Road intersections were modelled using SIDRA software for both years 2007 and 2010. The model used existing intersection layout and control types. Four performance measures detailed above are estimated using SIDRA. LoS results for year 2007 and 2010 are presented in Table 2-13 and Table 2-14 respectively.

Table 2-13 Intersection LoS for 2007 traffic conditions

ID	Name	Control Type	DOS	Ave Delay (s)	LOS	Queue (veh)
	AM peak					
I-01	Pacific Hwy-Flowers Dr	Stop sign	0.30	72	**F**	2
I-02	Pacific Hwy-Montefiore St	Seagull	0.17	16	**B**	1
I-03	Flowers Dr-Northwood Rd	Give-way	0.01	8	**A**	1
	PM Peak					
I-01	Pacific Hwy-Flowers Dr	Stop sign	0.74	>100	**F**	3
I-02	Pacific Hwy-Montefiore St	Seagull	0.19	16	**B**	1
I-03	Flowers Dr-Northwood Rd	Give-way	0.02	7	**A**	1

Note: For sign controlled intersections LoS is determined by worst movement (highest delay)

Table 2-14 Intersection LoS for 2010 traffic conditions

ID	Name	Control Type	DOS	Ave Delay (s)	LOS	Queue (veh)
	AM peak					
I-01	Pacific Hwy-Flowers Dr	Stop sign	0.37	79	**F**	2
I-02	Pacific Hwy-Montefiore St	Seagull	0.18	17	**B**	1
I-03	Flowers Dr-Northwood Rd	Give-way	0.01	8	**A**	1
	PM Peak					
I-01	Pacific Hwy-Flowers Dr	Stop sign	0.95	>100	**F**	5
I-02	Pacific Hwy-Montefiore St	Seagull	0.21	17	**B**	1
I-03	Flowers Dr-Northwood Rd	Give-way	0.02	7	**A**	1

Note: For sign controlled intersections LoS is determined by worst movement (highest delay)

The worst (highest delays) movements, as per 2010 models, for each intersection are identified in Table 2-15.

Table 2-15 Movements with the highest delays as per 2010 models

ID	Name	Control Type	Worst Movements
	AM peak		
I-01	Pacific Hwy-Flowers Dr	Stop sign	* 19 veh right turn from Flowers Dr (DoS=0.37; LoS=F) * 1 cross traffic veh between Flowers Dr & Cams Wharf Rd (DoS=0.03; LoS=E); * 4 veh right turn from Pacific Hwy to Flowers Dr (DoS=0.01; LoS=B);
I-02	Pacific Hwy-Montefiore St	Seagull	* 3 veh right turn from Montefiore St (DoS=0.01; LoS=B); * 15 vehs right turn from Pacific Hwy (DoS=0.02; LoS=B);
I-03	Flowers Dr-Northwood Rd	Give-way	* 6 veh right turn from Northwood Rd (DoS=0.01; LoS=A); * 1 veh right turn from Flowers Dr (DoS=0.01; LoS=A);
	PM Peak		
I-01	Pacific Hwy-Flowers Dr	Stop sign	* 22 veh right turn from Flowers Dr (DoS=0.95; LoS=F); * 1 cross traffic veh between Flowers Dr and Cams Wharf Rd(DoS=0.04; LoS=F); * 2 veh right turn from Pacific Hwy to Flowers Dr (DoS=0.01; LoS=B);
I-02	Pacific Hwy-Montefiore St	Seagull	* 1 veh right turn from Montefiore St (DoS=0.01; LoS=A); * 26 veh right turn from Pacific Hwy (DoS=0.04; LoS=B);
I-03	Flowers Dr-Northwood Rd	Give-way	* 1 veh right turn from Northwood Rd (DoS=0.01; LoS=A); * 2 veh right turn from Flowers Dr (DoS=0.01; LoS=A);

Key observations from Table 2-14 and Table 2-15 (2010 traffic conditions) are noted below:

- There was no significant change in the intersections performance results between 2007 and 2010 traffic conditions. Level of Service (LoS) for all modelled intersections, during AM and PM peak periods, remained unchanged.
- At Pacific Highway/Flowers Drive/ Cams Wharf Road intersection, right turn movement out of Flowers Drive was delayed by 79 sec (LoS F) in AM Peak. However DoS was 0.37. The DoS values increased during PM peak to 0.95. About 19 to 22 right turn vehicles out of Flowers Drive delayed with LoS F;
- Pacific Highway/ Montefiore Street intersection has adequate capacity with DoS 0.18 to 0.21 and LoS B;
- Local intersection at Flowers Drive/Northwood Road has adequate capacity with LoS A.

3 Impact assessment

3.1 Additional development trips

Peak hour trips for Catherine Hill Bay (Middle Camp) development were estimated based on the RTA's trip generation guideline "The Guide to Traffic Generating Developments, RTA, 2002. A conservative trip generation rate for dwellings of 0.85 vehicle trips per peak hour was adopted. The percentage of internal trips for the Catherine Hill Bay development would be negligible. The yield of 222 dwellings will generate about 189 peak hour trips.

3.2 Future trip distribution and growth on the Pacific Highway

In assessing the traffic impact from the Catherine Hill Bay (Middle Camp) site, the following assumptions were made into the spreadsheet traffic model including:

- Future traffic distribution to and from Catherine Hill Bay (Middle Camp) site;
- Traffic distribution to and from other developments. This included Coal & Allied sites at Nords Wharf and Gwandalan, and potential future development of the Rose Group zoned sites at Gwandalan and Catherine Hill Bay;
- Background traffic growth on the Pacific Highway.

Future traffic distribution from both Coal & Allied and the Rose Group zoned sites together with background growth on the Pacific Highway are summarised in Table 3-1. A 2% traffic growth rate per annum on the Pacific Highway in the next 10 years is appropriate, and is consistent with historical growth observed at RTA's permanent count site two kilometres south of Macquarie Bridge at Swansea.

Table 3-1 Trip distribution and background traffic growth assumptions

Developers	Sites	General model assumptions and data
Coal & Allied	Middle Camp	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2012; 60 % of trips would travel north to/from Newcastle via Pacific Highway/Flowers Drive intersection under existing intersection controls; 40 % of trips would travel south to/from Wyong/Gosford areas via Pacific Highway/Montefiore Street under existing intersection controls;
Coal & Allied	Gwandalan	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2018; 20 % of trips would travel north to/from Newcastle via Pacific Highway/Kanangra Drive Intersection; 80 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Kanangra Drive intersection;
Coal & Allied	Nords Wharf	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2011; 60 % of trips would travel north to/from Newcastle via Pacific Highway/Awabakal Drive intersection; 40 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Awabakal Drive Intersection;
Rose Group	Catherine Hill Bay	60 % of trips would travel north to/from Newcastle and would use both the Pacific Highway/Flowers Drive and the Pacific Highway/Montefiore Street intersections under existing intersection controls; 40 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Montefiore Street under existing intersection controls; Future horizon year for full development is 2018. By 2012, no additional traffic from Rose Group sites.
Rose Group	Gwandalan	During the morning peak, around 70% of total traffic in and out of Gwandalan/Summerland Point is outbound, and in the evening peak, around 65% is inbound; Future horizon year for full development is 2018
-		A conservative estimate of 2% per annum background traffic growth on the Pacific Highway; Peak hour through traffic for holiday period would increase by about 10% above the weekday counts. In the instance of potential delays to Coal & Allied developments at Nords Wharf and Middle Camp, the study has assessed the cumulative traffic impact at key intersections with the Pacific Highway up to year 2018.

3.3 Future forecast and impact on key intersections

Hyder prepared traffic forecast for following three scenarios:

- S1 represents the base case;
- S2 represents the base case plus Coal & Allied Middle Camp development traffic;
- S3 cumulative impact considering other potential developments in and around Catherine Hill Bay.

The trip generation rate from 222 dwellings was applied to scenarios S2 and S3. Table 3-2 summarised assumptions made for modelling three scenarios.

Table 3-2 Scenario description

The scenarios	Description
S1 Base Case	Reflects background traffic growth of 2% per annum on the Pacific Highway
S2 Development Case	Reflects Base Case (S1) plus proposed full development at Coal & Allied Middle Camp. This provides impact of Middle Camp development alone.
S3 Cumulative Case	Reflects Development Case (S2) plus all other proposed developments including Nords Wharf , Gwandalan and potential development of the Rose Group zoned sites at Catherine Hill Bay and Gwandalan

Intersection performance was reported in terms of degree of saturation (DoS), level of service (LoS), average delay per vehicle and 95th percentile queue length. Results are summarised at Pacific Highway/Flowers Drive, Pacific Highway/Montefiore Street and Flowers Drive/Northwood Road intersections as follows:

- Table 3-3 shows SIDRA results for the *base case S1*
- Figure 3-1 shows turning movements for the *base case S1*
- Table 3-4 shows SIDRA results for the *development case S2*
- Figure 3-2 shows turning movements for the *development case S2*
- Table 3-5 shows SIDRA results for the *cumulative case S3*
- Figure 3-3 shows turning movements for the *cumulative case S3*

Table 3-3 Intersection performance at Pacific Highway intersections (Base Case S1)

Site ID	Intersection	Control	Year 2010				Middle Camp (Base Case S1)			
			DoS	Delays (S)	LoS	Queue (Veh)	DoS	Delays (S)	LoS	Queue (Veh)
	Morning peak									
I-1	Pacific Hwy-Flowers Dr	Stop	0.37	79	F	2	0.40	>100	F	2
I-2	Pacific Hwy-Montefiore St	Seagull	0.18	17	B	1	0.18	17	B	1
	Evening peak									
I-1	Pacific Hwy-Flowers Dr	Stop	0.95	>100	F	5	1.00	>100	F	6
I-2	Pacific Hwy-Montefiore St	Seagull	0.21	17	B	1	0.21	17	B	1

Note: Intersection performance results from background growth (base case) on Awabakal Dr and Kanangra Drive intersections with Pacific Highway are summarised in Coal & Allied's Nords Wharf and Gwandalan traffic reports prepared by Hyder.

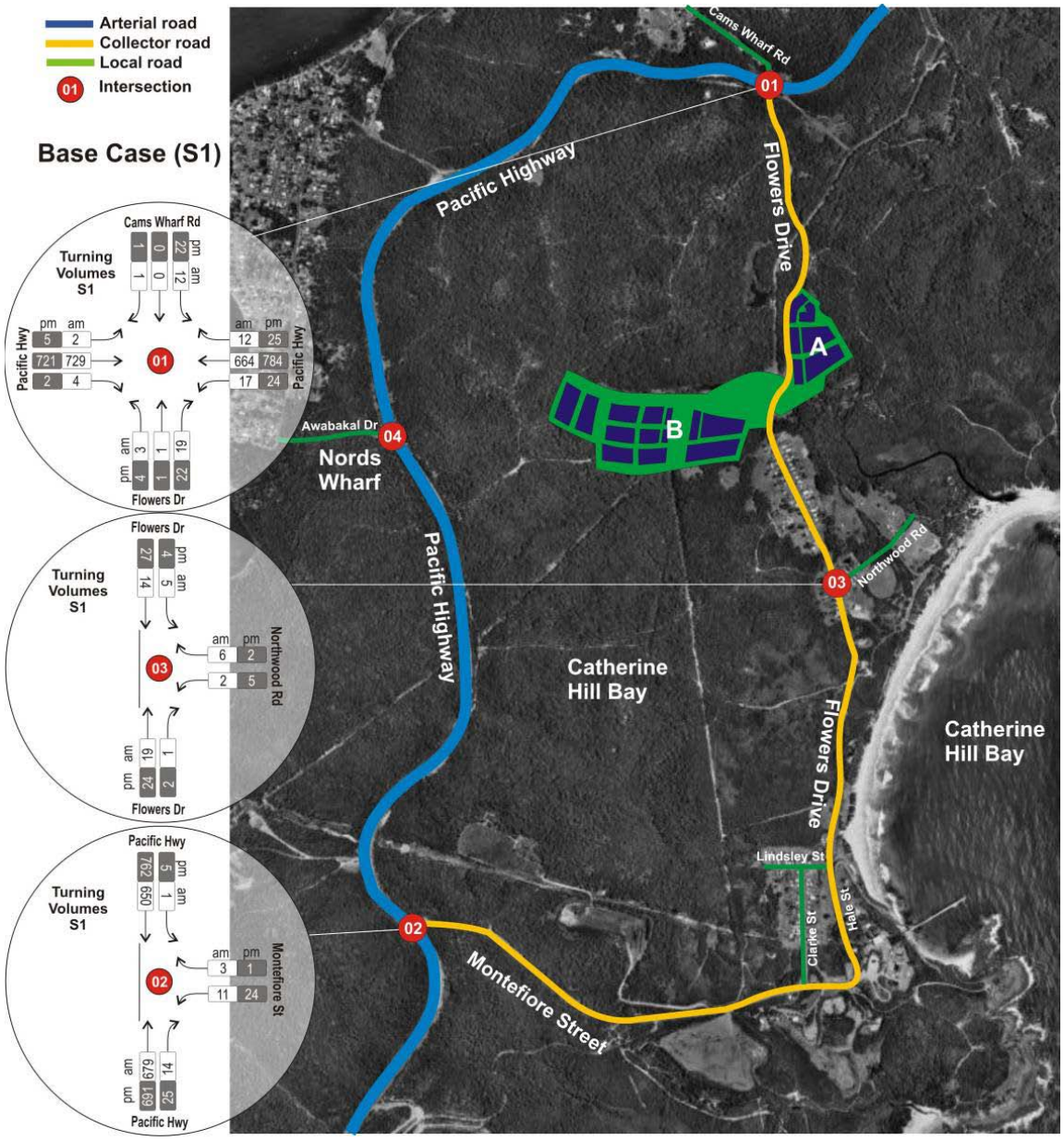


Figure 3-1 Forecasts of intersection turning volumes with Base Case S1

Table 3-4 Intersection performance with Catherine Hill Bay full development (Development Case S2)

ID	Intersection	Control	DoS	AVG Delay (s)	LoS	Que (veh)	Critical Movements
	AM						
I-01 AM	Pacific Hwy-Flowers Dr	Stop	1.92	>100	F	42	109 veh right turn from Flowers Dr DoS=1.92, LoS=F; 1 cross traffic veh between Flowers Dr and Cams Wharf Rd DoS=0.02, LoS=B 4 veh right turn from Pacific Hwy to Flowers Dr DoS=0.01, LoS=B;
I-02 AM	Pacific Hwy-Montefiore St	Seagull	0.18	18	B	1	3 veh right turn from Montefiore St DoS=0.01, LoS=B; 29 veh)right turn from Pacific Hwy DoS=0.04, LoS=B;
I-03 AM	Flower Dr-Northwood Rd	Give-way	0.04	8	A	1	6 veh right turn from Northwood Rd DoS=0.01, LoS=A; 1 veh right turn from Flowers Drive DoS=0.02, LoS=A;
	PM						
I-01 PM	Pacific Hwy-Flowers Dr	Stop	1.00	>100	F	7	44 veh right turn from Flowers Dr DoS=1.00, LoS=F; 1 cross traffic veh between Flowers Dr and Cams Wharf Rd, DoS=0.05, LoS=F; 2 veh right turn from Pacific Hwy to Flowers Dr DoS=0.01, LoS=C;
I-02 PM	Pacific Hwy-Montefiore St	Seagull	0.21	17	B	1	1 veh right turn from Montefiore St DoS=0.003, LoS=A; 86 veh right turn from Pacific Hwy DoS=0.14, LoS=B;
I-03 PM	Flower Dr-Northwood Rd	Give-way	0.05	7	A	1	2 veh right turn from Northwood Rd DoS=0.006, LoS=A; 2 veh right turn from Flowers Dr DoS=0.05, LoS=A;

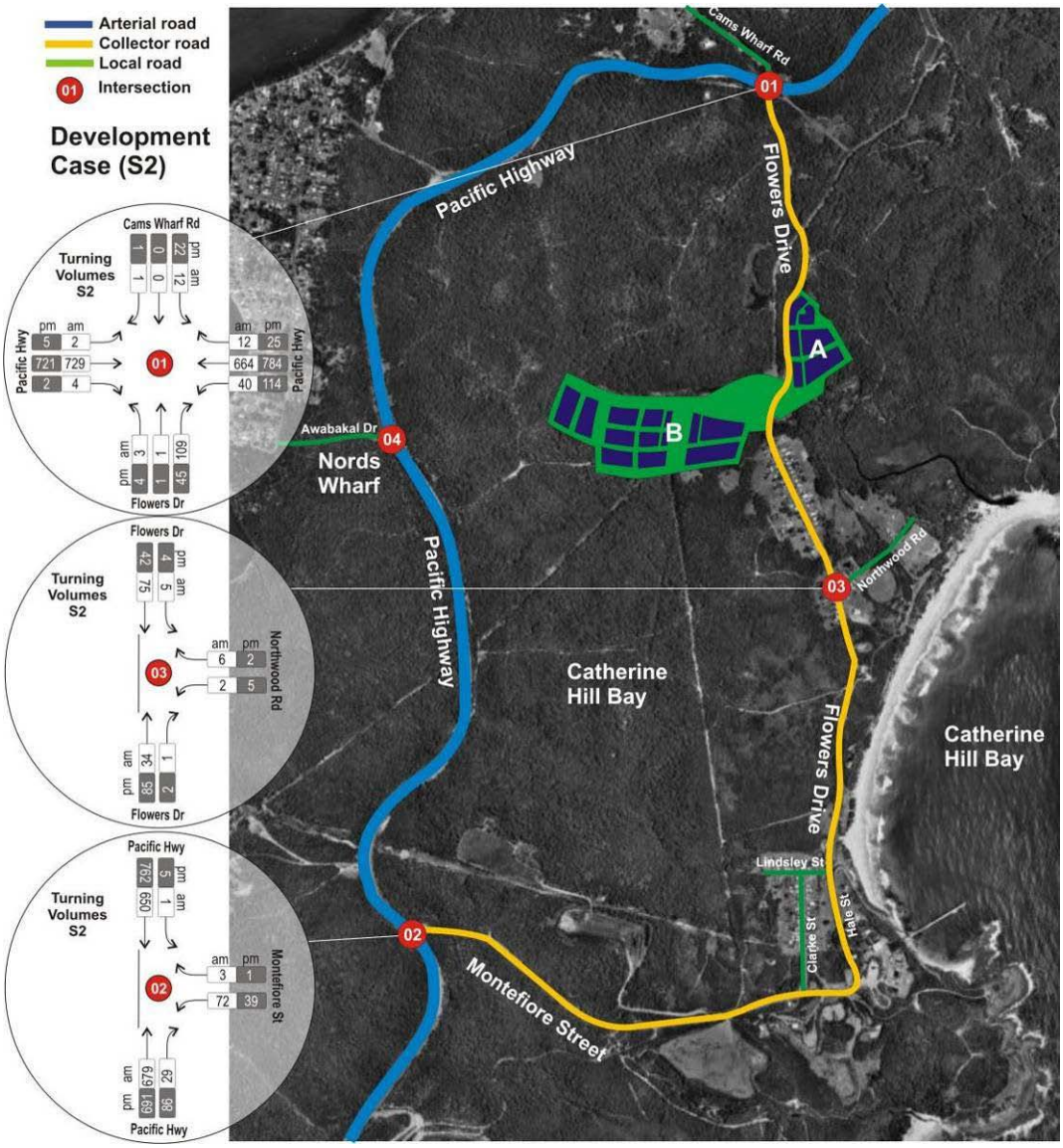


Figure 3-2 Forecasts of intersection turning volumes with full Catherine Hill Bay development (Development Case S2)

Table 3-5 Intersection performance with cumulative traffic impact (Development Case S3)

ID	Intersection Name	Control Type	DOS	LOS	Queue (veh)	Critical Movements
	Morning Peak					
I-01 AM	Pacific Hwy-Flowers Dr	Stop sign	2.36	**F**	60	135 veh right turn from Flowers Dr DoS=2.36, LoS=F; 1 cross traffic veh between Flowers Dr & Cams Wharf Rd, DoS=0.11, LoS=F; 10 veh right turn from Pacific Hwy to Flowers Dr, DoS=0.02, LoS=B;
I-02 AM	Pacific Hwy-Montefiore St	Seagull	0.41	**B**	2	111 veh right turn from Montefiore St DoS=0.32, LoS=B; 180 veh left turn from Montefiore St DoS=0.41, LoS=B;
I-03 AM	Flower Dr-Northwood Rd	Give-way	0.05	**A**	1	6 veh right turn from Northwood Rd DoS=0.01, LoS=A; 1 veh right turn from Flowers Dr DoS=0.03, LoS=A;
	Evening Peak					
I-01 PM	Pacific Hwy-Flowers Dr	Stop sign	1.00	**F**	10	50 veh right turn from Flowers Dr DoS=1.00, LoS=F; 1 cross traffic veh between Flowers Dr & Cams Wharf Rd, DoS=0.23; LoS=C; 22 veh right turn from Pacific Hwy to Flowers Dr, DoS=0.07; LoS=B;
I-02 PM	Pacific Hwy-Montefiore St	Seagull	0.38	**B**	2	22 veh right turn from Montefiore St DoS=0.08, LoS=B; 167 veh right turn from Pacific Hwy DoS=0.38, LoS=B;
I-03 AM	Flower Dr-Northwood Rd	Give-way	0.05	**A**	1	2 veh right turn from Northwood Rd DoS=0.01, LoS=A; 2 veh right turn from Flowers Dr DoS=0.05, LoS=A

Note: Intersection performance results from cumulative growth (cumulative case) on Awabakal Dr and Kanangra Drive intersections with Pacific Highway are summarised in Coal & Allied's Nords Wharf and Gwandalan traffic reports prepared by Hyder.

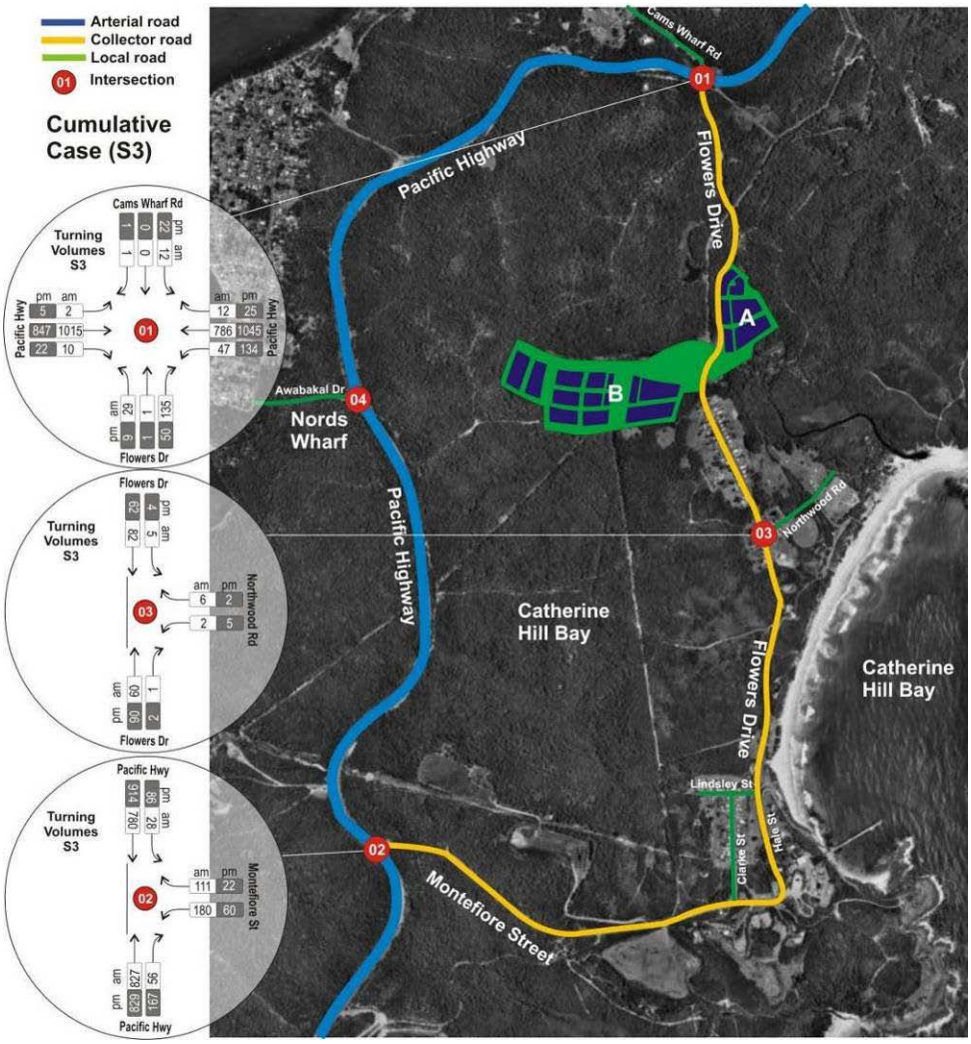


Figure 3-3 Forecasts of intersection turning volumes with cumulative impact (Development Case S3)

Key findings from Table 3-3 to Table 3-5 are summarised as follows:

- At present, the Pacific Highway/Flowers Drive intersection shows LoS F for the right turn from Flowers Drive and DoS between 0.37 and 0.95 for AM and PM peak. The right turn movement out of Flowers Drive experienced delays of more than two minutes due to conflicting movements in a four way stop sign junction. The data suggests that right turn movements in and out of Cams Wharf Road are relatively small. The Pacific Highway/Montefiore Street intersection shows LoS B with critical movements DoS between 0.17 and 0.19 for AM and PM peak. This intersection does not show a capacity problem under existing traffic conditions.
- For the *base case S1*, the Pacific Highway/Flowers Drive and Pacific Highway/Montefiore Street intersections is predicted a minor impact attributable to background growth on the Pacific Highway.
- Modelling results suggests the Coal & Allied development (*under development case S2*) at Catherine Hill Bay (Middle Camp) will have some impact primarily on the Pacific Highway at Flowers Drive intersection. The traffic model suggests LoS

F with DoS between 1.0 and 1.92 for PM and AM peaks (right turn out of Flowers Drive).

- Pacific Highway/Montefiore Street intersection under *development case S2* shows LoS B with slightly increased DoS between 0.18 and 0.21 for the AM and PM peaks. This suggests Montefiore Street intersection does not show a significant capacity problem with the Coal & Allied Middle Camp development alone.
- Under *cumulative case S3*, the Pacific Highway/Montefiore Street intersection is predicted with a LoS B but with increased DoS between 0.38 and 0.41 for PM and AM peak. The additional impact at this intersection is primarily driven by the growth from the potential development yield for the Rose Group zoned site. Similarly, the model predicts additional impact at Pacific Highway/ Flowers Drive from development of the Rose Group zoned site. The model suggests DoS between 1.0 and 2.36 for the PM and AM peak (right turn from Flowers Drive). The analysis therefore suggests that additional traffic generated by the Coal & Allied Middle Camp development in conjunction with expected cumulative growth from potential development of Rose Group zoned site in Catherine Hill Bay will impact the performance of Pacific Highway/Cams Wharf Road/ Flowers Drive and Pacific Highway/ Montefiore Street intersections.

3.4 Access strategy with the Pacific Highway

The external road network serving the Coal & Allied Middle Camp proposed development comprises Flowers Drive and Montefiore Street, both linking to the Pacific Highway. Coal & Allied previously established the broad access management strategy for the Catherine Hill Bay and Nords Wharf precincts in consultation with the RTA and Lake Macquarie City Council. The access management strategy, to accommodate the cumulative impact of both Coal & Allied proposed development at Middle Camp Nords Wharf and the potential development yield for the Rose Group residential zoned land in Catherine Hill Bay indicated that intersections on the Pacific Highway at Flowers Drive, Montefiore Street and Awabakal Drive would require modification (upgrade) to minimise the impact of the additional traffic. The proposed modification was as follows:

- Left in and left out at Flowers Drive with Pacific Highway
- Partial signals at Montefiore Street with Pacific Higwhay
- Partial signals at Awabakal Drive with Pacific Highway

3.4.1 Impact on Cams Wharf Road

A further traffic impact analysis was undertaken for Cams Wharf Road at the Pacific Highway/Flowers Drive/Cams Wharf Road intersection. The analysis considered the above mentioned traffic management measures proposed at three key intersections with the Pacific Highway:

Pacific Highway/Flowers Drive/Cams Wharf Road intersection is a four-way STOP sign-controlled intersection, with painted channelisation. Acceleration and deceleration lanes for left and right turns both into and out of the two side roads are provided. The Pacific Highway (through route) has two through lanes per direction. Although the Pacific Highway is a single carriageway road, the sections both north and south of this intersection are divided by a painted median and wire rope safety barrier. There are no provisions for a staged crossing since this is a four-leg intersection.

The peak hour traffic data collected during July 2007 showed that just one vehicle from Cams Wharf Road turned right to Pacific Highway south during the peak hour (see Figure 2.4). Hyder also assessed three hours count data, which suggested only three vehicles turned right from Cams Wharf Road. The cross traffic movements between Flowers Drive and Cams Wharf Road were small being 1 to 2 vehicles per hour.

The traffic forecasts suggested that there will be no impact on Cams Wharf Road as a result of the proposed Coal & Allied development at Middle Camp. Due to the small right turn out movement from Cams Wharf Road, this turn can be banned. The provision of a new partial signal at Awabakal Drive with Pacific Highway can accommodate a small traffic increase should the right turn be banned at Cams Wharf Road. This new arrangement will have a safety benefit at Flowers Drive/ Cams Wharf Road/ Pacific Highway intersection, but will result in only a relatively small travel time increase for Cams Wharf residents. Figure 3.4 shows an indicative traffic arrangement should the right turn from Cams Wharf Road to Pacific Highway south be banned.

The right turn movement from Cams Wharf Rd to Pacific Highway will be deleted by agreement with the RTA and Lake Macquarie City Council for safety reasons and traffic studies indicated very little use of this access.

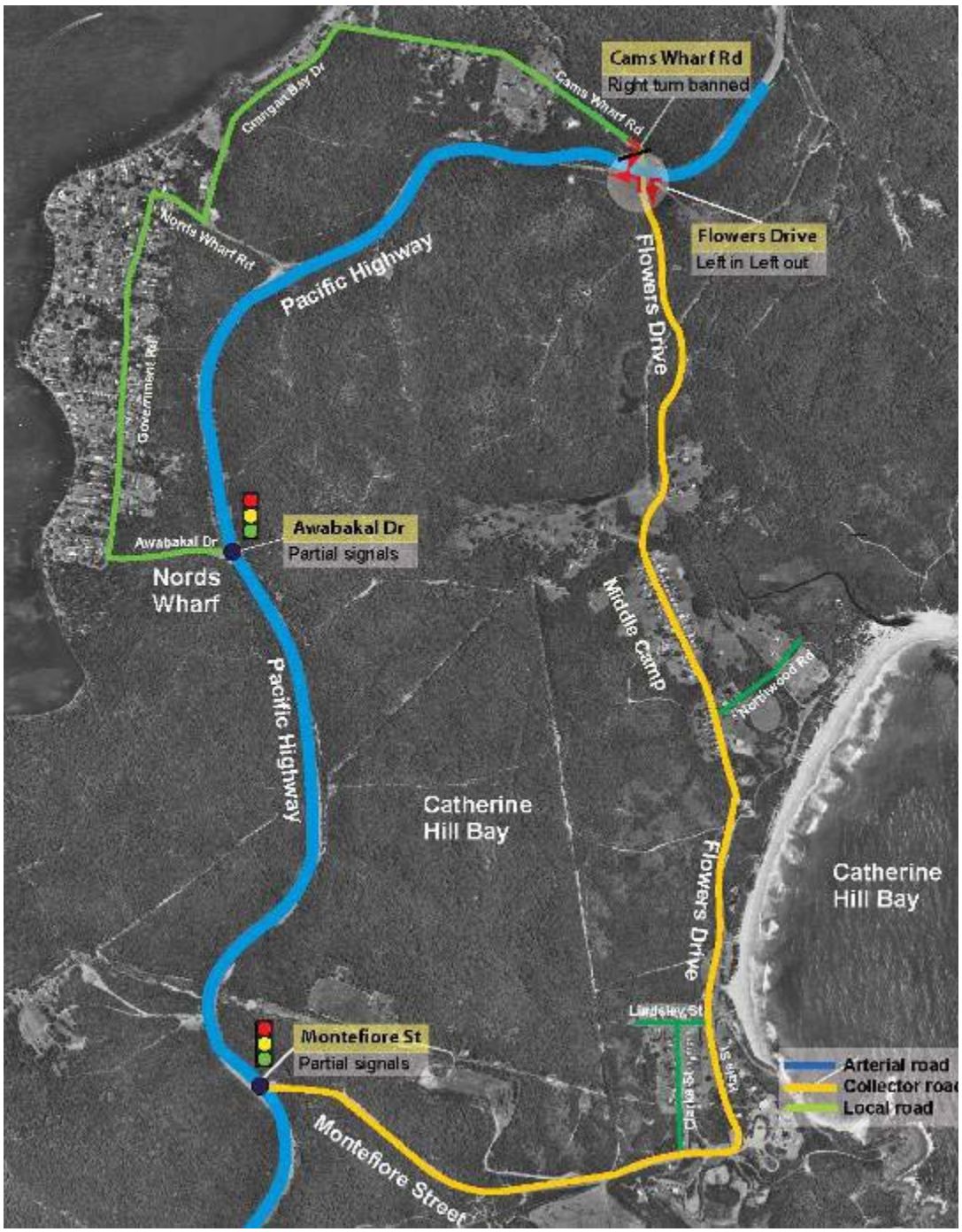


Figure 3-4 Indicative traffic arrangements for banned right turn from Cams Wharf Road to Pacific Highway

3.5 Testing of upgrading works

Previous section 3.4 outlined the access management strategy at Flowers Drive and Montefiore St with the Pacific Highway. The need for proposed upgrading works was identified for mitigating the cumulative impact from both Coal & Allied and Rose Group sites in Catherine Hill Bay.

The agreed proposed upgrades with the Pacific Highway comprised the following modifications:

- Cams Wharf Road/ Flowers Drive: maintain right turn from Pacific Highway to Cams Wharf Road. Ban right turn from Cams Wharf Road onto Pacific Highway. Flowers Drive traffic will be restricted to left in/left out only;
- Montefiore Street: provide a seagull intersection with full access to Montefiore Street and traffic signal control on the Pacific Highway southbound and Montefiore Street.

Figure 3-5 and Figure 3-6 show the preliminary conceptual design of proposed upgrade works at Pacific Highway/Flowers Drive and Pacific Highway/Montefiore Street intersections for a post upgrade condition.

Figure 3-5 Proposed conceptual intersection improvements at Pacific Highway/Flowers Drive intersection

Figure 3-6 Proposed conceptual intersection improvements at Pacific Highway/Montefiore Street intersection

Table 3-6 shows intersection performance for cumulative traffic for a post upgrade condition. Traffic modelling predicted critical DoS value for Flowers Drive and Montefiore Street intersections between 0.32 and 0.53 within the acceptable threshold. The analysis suggests that proposed upgrading works will be effective to reduce the adverse impact from the Coal & Allied development and future development of the Rose Group zoned sites.

Table 3-6 Intersection performance for 2018 cumulative conditions (for upgrade Option, weekday condition)

Site ID	Intersection	Control type	Upgrade Condition			
			DoS	Delays (S)	LoS	Queue (Veh)
	Morning peak					
I-1	Pacific Hwy-Flowers Dr	Sign control, Left in left out on Flowers Dr, Cams Wharf Rd banned right turn out (see Figure 3-5)	0.33	40	C	1
I-2	Pacific Hwy-Montefiore St	Partial signals (see Figure 3-6)	0.51	15	B	13
	Evening peak					
I-1	Pacific Hwy-Flowers Dr	Sign control, Left in left out on Flowers Dr, Cams Wharf Rd banned right turn out (see Figure 3-5)	0.32	19	B	1
I-2	Pacific Hwy-Montefiore St	Partial signals (see Figure 3-6)	0.53	14	A	15

Note: Result in Table 3-6 assumed modifications at Flowers Drive and Montefiore St intersections with the Highway as per access strategy documented in Section 3.5.

For future proofing, intersection performance was tested with increased traffic on the Pacific Highway during the holiday periods (seasonal factor). The SIDRA model was re-run with a 10 percent traffic increase on the Pacific Highway. Table 3-7 shows intersection performance with seasonal factor. The result indicated that both intersections with the Pacific Highway are forecast to operate at satisfactory LoS during the critical holiday period.

Table 3-7 Intersection performance for 2018 cumulative condition (for upgrade Option, peak holiday condition)

Site ID	Intersection	Control type	Upgrade Condition			
			DoS	Delays (S)	LoS	Queue (Veh)
	Morning peak					
I-1	Pacific Hwy-Flowers Dr	Sign control, Left in left out on Flowers Dr, Cams Wharf Rd banned right turn out (see Figure 3-5)	0.36	50	D	1
I-2	Pacific Hwy-Montefiore St	Partial signals (see Figure 3-6)	0.54	14	B	14
	Evening peak					
I-1	Pacific Hwy-Flowers Dr	Sign control, Left in left out on Flowers Dr, Cams Wharf Rd banned right turn out (see Figure 3-5)	0.36	21	B	1
I-2	Pacific Hwy-Montefiore St	Partial signals (see Figure 3-6)	0.55	13	A	15

Considering the close proximity of Coal & Allied development to the Pacific Highway/Flowers Drive intersection, it is plausible that some northbound commuters may use Flowers Drive, turning left (as right turn will be banned) and then making a u-turn on the Pacific Highway. To verify the traffic implication of this assumption, Hyder analysed travel times on alternative routes for northbound traffic from the Coal & Allied Catherine Hill Bay development.

Figure 3-7 shows northbound traffic route via Flowers Drive, Montefiore Street, and Pacific Highway (route 1). Total travel time for route 1 is estimated approximately 7.5 minutes including delays at Pacific Highway/Montefiore proposed signals. In Figure 3-7 an alternative route is also showed for northbound traffic exiting left from Flowers Drive and then making a U-turn at Pacific Highway/Nords Wharf Road intersection (route 2). Total travel time for route 2 is estimated approximately 3.6 minutes including delays at Pacific Highway/Flowers Drive intersection and time required for a U-turn.

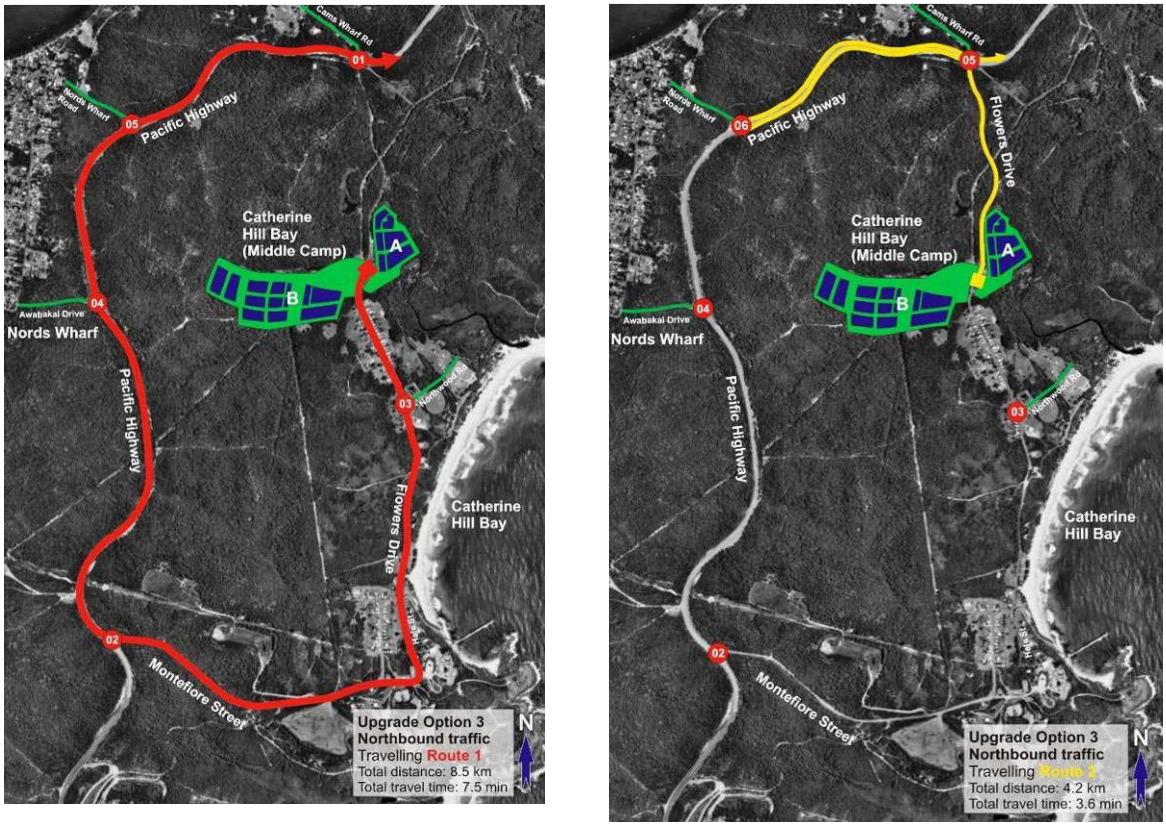


Figure 3-7 Possible travelling routes and associated travel times for northbound traffic from Coal & Allied Catherine Hill Bay Development

The travel time data suggests that route 2 can be attractive to a small percentage of northbound traffic, although the proposed signals at Montefiore St are expected to provide safer right turn facility for northbound traffic. Hyder assessed the possible implication of U-turn movement on the Pacific Highway via Flowers Drive. The U-turn facility on the Pacific Highway is not required for the following reasons:

- Low traffic volume. If maximum of 10% of northbound traffic were to use Flowers Drive then about 27 vehicles (during worst peak hour) might use a U -turn facility. This is unlikely to be justifiable from a cost benefit perspective. From a road safety perspective, the majority of northbound traffic should use the Montefiore Street signalised intersection.
- There was insufficient sight distance to allow the U-turn to be completed safely; or there was insufficient road and shoulder width to provide the widening required to develop the U-turn facility.

The right turn lane on the Pacific Highway at Nords Wharf intersection has adequate sight distance which allows a U-turn from the existing right turn lane. A U-turn at this location is already permitted under the current road rules.

3.6 Impact from concept plan

Hyder prepared traffic forecasts on key access points and internal roads within the subdivision. Table 3-8 presents the forecast with development traffic at Middle Camp. Traffic was forecast for both peak and daily conditions. Figure 3-8 shows locations where traffic changes are predicted from development traffic in conjunction with existing redistributed traffic from proposed right turn ban at Flowers Drive. In general, the Coal & Allied development at Middle Camp will increase peak hour traffic between 20 and 170 vehicles per hour depending on location. On Flowers Drive traffic is forecast to increase between 600 and 1400 vehicles per day. The highest traffic increase is forecast on Flowers Drive, Middle Camp (about 1400 vehicles per day) from a combined effect of development and redistributed existing traffic from right turn ban proposed at Flowers Drive with the Pacific Highway.

Figure 3-8 Middle Camp concept plan showing forecasts locations (indicative lot layout)

Note: Location number 1 is on Pacific Highway and location number 4 is on Montefiore Street

Table 3-8 Existing and future forecast on key roads

Location	Road	Classification	Existing			Existing plus development traffic-2012 (turn ban at Flowers Drive in place)			Change (due to development traffic and turn ban effect on existing traffic)		
			AM	PM	Daily	AM	PM	Daily	AM	PM	Daily
1	Pacific Hwy, south of Awabakal Dr	Arterial	1,120	1,250	14,500	1,320	1,400	16,500	200	150	2,000
2	Flowers Dr, south of Pacific Hwy	Collector Road	50	50	730	70	160	1,330	20	110	600
3	Flowers Dr, through Middle Camp, north of Northwood Rd	Collector Road	50	50	730	220	130	2,130	170	80	1,400
4	Montefiore St, east of Pacific Hwy	Collector Road	20	40	510	190	120	1,910	170	80	1,400
5	Northwood Rd, east of Flowers Dr	Local Road	15	10	120	15	10	120	0	0	0
10	Access Rd	Local Road	-	-	-	40	40	400	40	40	400
11	Access Rd	Local Road	-	-	-	30	30	300	30	30	300
12	Access Rd	Local Road	-	-	-	50	50	500	50	50	500
13	Access Rd	Local Road	-	-	-	10	10	100	10	10	100

Note: The existing and future traffic data shown in Table 3.8 were based on weekday (Friday) traffic. Existing traffic data is as per 2007 counts. For site 3, no count data was available. For a worst case impact assessment at site 3, Hyder assumed similar traffic data from nearby site 2. The 2012 forecast has assumed proposed traffic management measures at Flowers Drive with Pacific Highway. No LATM measure on Flowers Drive (through Middle Camp) was assumed.

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Table 3-9 sets out the recommended Environmental Capacity performance standards on residential streets and has two value levels given, one for desirable maximum (environmental goal) and one for the absolute maximum.

Table 3-9 Environmental capacity performance standards on residential streets

Road class	Road type	Maximum speed (km/hr)	Maximum peak hour volume (vehicles/hr)	Maximum daily volume (vehicles/day)
Local	Access way	25	100	1000
	Street	40	200 environmental goal	2000 environmental Goal
			300 maximum	3000 maximum
Collector	Street	50	300 environmental goal	3000 environmental goal
			500 maximum	5000 maximum

Source: RTA Guide to Traffic Generating Developments, October 2002, Table 4.6 in Section 4

Table 3-10 summarised maximum forecast traffic on key local roads for a post development condition. Noting proposed right turn ban at Flowers Drive with Pacific Highway will result in existing traffic redistribution on Flowers Drive and Montefiore Street. The maximum traffic volume was compared with the RTA's recommended environmental capacity performance standards. The traffic data from Table 3.10 suggested that future highest traffic volumes on key local roads would be within the environmental capacity standard recommended by the RTA.

Table 3-10 Future forecast volumes on key roads compared with RTA's environmental performance standards

Road	Road Class	Max Volumes		RTA's environmental goal for peak hour volumes	RTA's environmental goal for daily volumes
		Peak	Daily		
Flowers Drive	Collector	220	2130	Satisfied	Satisfied
Montefiore Street	Collector	190	1910	Satisfied	Satisfied
Northwood Road	Local Road	15	120	Satisfied	Satisfied
Access Roads at locations 10-13	Local Roads	50	500	Satisfied	Satisfied

Note: The traffic data in Table 3-10 represents for year 2012 forecast. The data assumed full development from Coal & Allied at Catherine Hill Bay takes place in year 2012. No additional traffic from Rose Group is assumed in year 2012

3.7 Traffic forecast on Flowers Drive through Middle Camp for noise assessment

A detailed noise assessment was undertaken on Flowers Drive through Middle Camp considering the potential impact from the proposed Coal & Allied development. The noise assessment also takes into account the traffic influence from the potential development yield from the Rose Group residential zoned site and traffic management measures proposed at both ends of the Pacific Highway intersections. Noting in 2012, no additional traffic was assumed from Rose Group site. Traffic analysis in Table 3.8 shows traffic forecast on the Flowers Drive in year 2012 to be about 2130 vehicles per day. This forecast was based on actual traffic data collected during winter period (July 2007) and without applying any seasonal factor in the forecast. Also, this forecast was based on the critical weekday traffic data rather than a seven days average traffic data required for detailed noise assessment. The forecast in Table 3.8 assumed that Flowers Drive through Middle Camp will maintain the current speed limit of 50 kilometres per hour (kph).

In the context of noise estimates a traffic scenario was prepared for Flowers Drive (through Middle Camp) by making the following assumptions:

- Middle Camp residents concerns regarding increased traffic volume on Flowers Drive. Local Area Traffic Management Measure (LATM) on Flowers Drive was considered as an effective solution which would reduce future traffic through Middle Camp;
- The LATM could be in the form of reducing the speed limit to 40 kph and installing speed humps at regular intervals on Flowers Drive through Middle Camp; and
- With LATM in place, we also expect there would be redistribution of future traffic from both the Coal & Allied proposed development and potential development yield on Rose Group zoned land. and
- A 10% increase in actual traffic data collected during July 2007 to represent some influence of seasonal factors in the absence of actual traffic counts data during the summer period. The 10% uplift factor was estimated from RTA's count site as follows.

Considering the area's proximity to the beach, Hyder anticipates that there would be additional vehicle trips during summer, particularly on weekends. Beach visitors from outside Catherine Hill Bay would generate additional trips. It is difficult to quantify the level of additional traffic generated from outside Catherine Hill Bay in association with beach activities. To determine a seasonal variation, a continuous data set for a period of 365 days is required. This level of data was not available for any local roads in Catherine Hill Bay. In the absence of this, data sources from the RTA for a one year period were used. This data was collected on the Pacific Highway near Swansea. Nevertheless, RTA's data provides a reliable source for determining seasonal impact between July and December traffic. RTA's data was the only count site on the Pacific Highway that provided a full 365 days count by each hour within the "area of influence" of the Coal & Allied sites. Figure 3.9 presents a traffic profile on the Pacific Highway for the year of 2006. As expected November and December traffic were the highest being about 10 percent higher than July traffic (when counts were undertaken). Detailed week by week traffic between July and December indicated, on Friday during December, traffic was between 7% and 10% above the flow during same time period of July (see Figure

3.10). As a safeguard, we assumed traffic in Catherine Hill Bay during the summer season would increase by about 10% above the July counts.

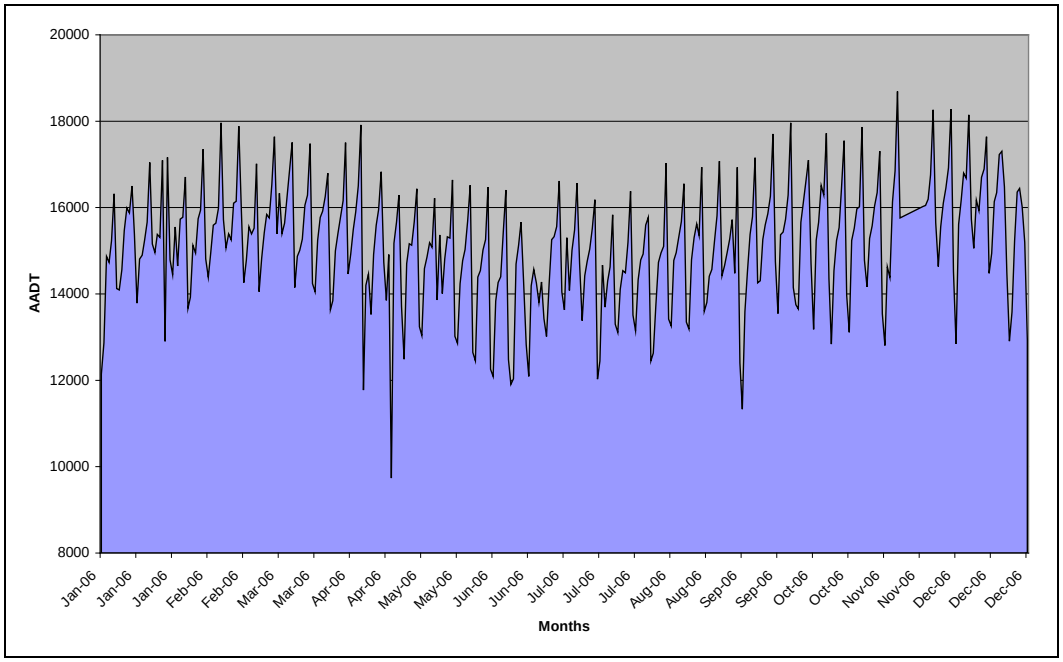


Figure 3-9 Pacific Highway traffic variations over one year period

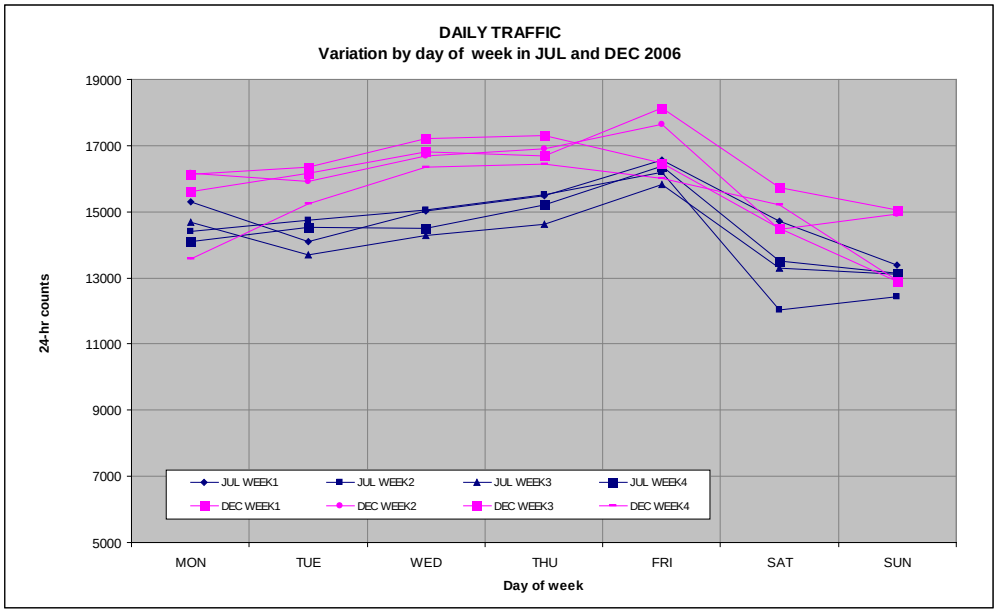


Figure 3-10 Comparison of July and December traffic for 2006 on Pacific Highway

With proposed left in/left out at Flowers Drive with Pacific Highway, a new partial signals at Montefiore Street with Pacific Highway and LATM measure on Flowers Drive through Middle Camp the following traffic distribution pattern was assumed:

- 50% of existing traffic from Pacific Highway previously used Flowers Drive would be diverted to Montefiore St for accessing Catherine Hill Bay. This reduction will result from left in/left out at Flowers Drive with Pacific Highway and LATM measures on Flowers Drive through Middle Camp;
- 90% of full Coal & Allied outbound traffic to North would travel via Montefiore St and Pacific Highway (i.e. via Flowers Dr through Middle Camp);
- 10% of full Coal & Allied outbound traffic to North would travel via Pacific Highway / Flowers Drive intersection and then make u-turn to the north;
- 70% of full Coal & Allied outbound traffic to South would travel via Pacific Highway / Flowers Drive intersection and then Pacific Highway;
- 30% of full Coal & Allied outbound traffic to South would travel via Montefiore St and Pacific Highway (ie. via Flowers Dr through Middle Camp);
- 100% of Coal & Allied inbound traffic from North would travel via Pacific Highway / Flowers Drive intersection;
- 100% of Coal & Allied inbound traffic from South would travel via Montefiore St and Pacific Highway (i.e. via Flowers Dr through Middle Camp);
- 100% from the potential yield of the of Rose Group zoned site inbound and outbound traffic from South would travel via Montefiore St and Pacific Highway;
- 100% from the potential yield of the of Rose Group zoned site inbound and outbound traffic from North would travel via Montefiore St and Pacific Highway.

Figure 3-11 shows future traffic distribution to and from Coal & Allied development which formed the basis of traffic forecast scenario on Flowers Drive (with LATM in place). Table 3-11 below summarised daily traffic forecasts on the Flowers Drive through Middle Camp with LATM in place. For ease of reference, existing 7 days average count data are also shown in Table 3-11.

Table 3-11 Daily Traffic forecast on Flowers Drive for noise assessment

2007/2010 Existing	2012 Forecast	Traffic increase
831	1575	744

Detailed travel time assumptions and hourly traffic distribution on the Flowers Drive are shown in Appendix A.

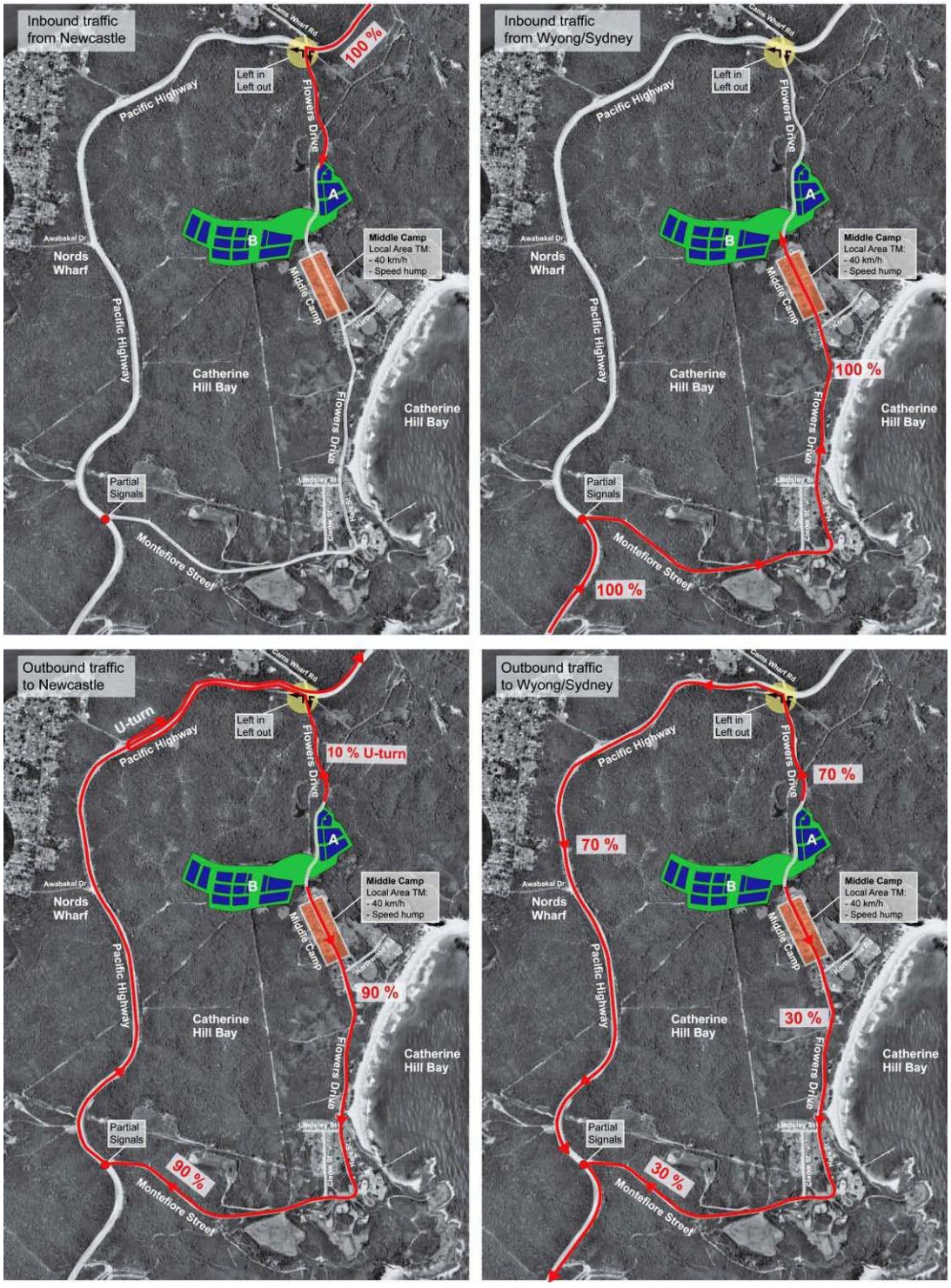


Figure 3-11 Assumed traffic distribution scenario on Flowers Drive (with LATM in place)

3.8 Impact at key Pacific Highway intersections without Rose Group development

The previous sections 3.2 to 3.5 outlined the access management strategy identified in consultation with the RTA and Lake Macquarie City Council. The access management strategy, to accommodate the cumulative impact of both the Coal & Allied proposed development and the potential development yield for the Rose Group residential zoned land indicated that intersections on the Pacific Highway at Flowers Drive and Montefiore Street would require modification (upgrade). The proposed upgrades arise from cumulative impact comprised the following modifications:

- Cams Wharf Road/ Flowers Drive: maintain right turn from Pacific Highway to Cams Wharf Road. Ban right turn from Cams Wharf Road onto Pacific Highway. Flowers Drive traffic will be restricted to left in/left out only;

- Montefiore Street: provide a seagull intersection with full access to Montefiore Street and traffic signal control on the Pacific Highway southbound and Montefiore Street.

In the event that the Rose Group proposed development does not proceed, it is expected that traffic impact will be relatively small from Coal & Allied development alone at Middle Camp. At Department of Planning (DoP)'s request, Coal & Allied has asked Hyder Consulting to investigate the impact of Coal & Allied development at both Pacific Highway/Flowers Drive and Pacific Highway/ Montefiore Street intersections without considering proposed Rose Group development.

In assessing traffic impact from Coal & Allied development at Middle Camp alone, Hyder has made similar traffic assumptions which are documented in previous Section 3.3. Hyder has determined intersection capacity for Coal & Allied development and existing traffic for the following two access strategy options. The intersection performance was estimated using the SIDRA traffic model.

1. Option 1: The Option 1 has varied the proposed intersection modifications at Pacific Highway/Flowers Drive. (a) Ban right turn from Pacific Highway to Cams Wharf Road. (b) Ban right turn from Cams Wharf Road onto Pacific Highway. (c) Flowers Drive traffic will be allowed for left in/ left out and right turn out movements. The Pacific Highway/Montefiore Street intersection is assumed as per existing layout and traffic control (no modifications).
2. Option 2: The Option 2 is similar to the modifications at Pacific Highway/Flowers Drive intersection which was identified for cumulative traffic. (a) Maintain right turn from Pacific Highway to Cams Wharf Road. (b) Ban right turn from Cams Wharf Road onto Pacific Highway. (c) Flowers Drive traffic will be restricted to left in/left out only. The Pacific Highway/Montefiore Street intersection is assumed as per existing layout and traffic control (no modifications).

Traffic distribution assumptions for access Option 1 and access Option 2 are presented in Appendix B. Both intersections were assessed for ultimate year 2018 traffic conditions for Coal & Allied development alone and existing traffic.

Table 3-12 summarised modelling results for access options 1 and 2 for ultimate year 2018. Both intersections are analysed for a 10% traffic increase on the Pacific Highway due to seasonal factors. Table 3-13 shows results from seasonal impact.

Table 3-12 Modelling results for option 1 and option 2 in 2018 (Weekday condition)

ID	Intersection	2010 (Existing)			2018 Forecast Access Option 1			2018 Forecast Access Option 2		
		DOS	Ave Delay (s)	LOS	DOS	Ave Delay (s)	LOS	DOS	Ave Delay (s)	LOS
	AM peak									
I-01	Pacific Hwy/Flowers Dr	0.37	79	**F**	0.24	23	**B**	0.27	23	**B**
I-02	Pacific Hwy/Montefiore St	0.18	17	**B**	0.21	22	**B**	0.35	23	**B**
	PM Peak									
I-01	Pacific Hwy/Flowers Dr	0.95	>100	**F**	0.29	26	**B**	0.28	19	**B**
I-02	Pacific Hwy/Montefiore St	0.21	17	**B**	0.24	19	**B**	0.24	24	**B**

Note: Access Option 1: Upgrade the Pacific Highway/Flowers Dr intersection as per RTA requirements. The design should incorporate for a right turn out movement from Flowers Drive as staged crossing with the adequate acceleration bay.

Table 3-13 Modelling results for option 1 and option 2 (with Seasonal factor)

ID	Intersection	2018 Forecast Access Option 1			2018 Forecast Access Option 2		
		DOS	Ave Delay (s)	LOS	DOS	Ave Delay (s)	LOS
	AM peak						
I-01	Pacific Hwy/Flowers Dr	0.26	24	**B**	0.29	25	**B**
I-02	Pacific Hwy/Montefiore St	0.23	24	**B**	0.38	25	**B**
	PM Peak						
I-01	Pacific Hwy/Flowers Dr	0.31	28	**B**	0.31	21	**B**
I-02	Pacific Hwy/Montefiore St	0.26	21	**B**	0.26	27	**B**

Note: Access Option 1: Upgrade the Pacific Highway/Flowers Dr intersection as per RTA requirements. The design should incorporate for a right turn out movement from Flowers Drive as staged crossing with the adequate acceleration bay.

The following points are noted from modelling results in Tables 3-12 and 3-13 from Coal & Allied development alone:

- The intersection of Pacific Highway/Montefiore St is projected to operate good level of service B. The existing intersection configuration at Montefiore Street with the Highway allows staged crossing for right turn traffic out of Flowers Drive. The

DoS value is projected to increase from 0.18/0.21 to 0.24/0.35 with full Coal & Allied development at Middle Camp. With a 10% uplift traffic on the Pacific Highway (peak holiday period), the DoS value is projected less than 0.4. The impact from Coal & Allied development at this intersection is predicted to be low;

- With proposed upgrade, Pacific Highway/Flowers Drive intersection is predicted with a better level of service than existing condition. The proposed upgrade at this intersection will improve traffic access performance significantly. Traffic model forecasts a good level of service B;
- The Option 1 which allows right turn movement out of Flowers Drive provides a better access outcome for Coal & Allied development. The Option 1 will be effective to reduce additional traffic through the Middle Camp (south of Coal & Allied development).Hyder proposes a further right turn ban from Pacific Highway to Cams Wharf Road. The existing traffic volume for this movement is low between 12 and 25 vehicles per hour. A safer right turn facility will be available further west at Nords Wharf Road or proposed signals at Awabakal Drive;

In the event that the proposed Rose Group development at Catherine Hill Bay does not proceed, Hyder recommend's that intersection of Pacific Highway/Flowers Drive/Cams Wharf Road is upgraded to RTA requirements according to Option 1 access strategy. The traffic analysis has determined low impact at Pacific Highway/Montefiore Street intersection. The traffic modelling result has identified no upgrading requirements of the Pacific Highway/Montefiore Street intersection deriving from existing traffic and the Coal & Allied development at Middle Camp.

The development will be carried out in accordance with the Environmental Assessment Report (EAR) prepared by Urbis and associated plans and supporting reports. Works in kind (WIK) relating to the upgrading of intersection of Pacific Highway/Flowers Drive will be concurrent with subdivision works to be completed prior to registration of the first stage subdivision.

3.9 Non-car modes strategy

Public transport in Catherine Hill Bay area is limited. The area is serviced directly by Busways Route 99 which runs from Lakehaven Shopping Centre and Swansea. The Busway operator was consulted regarding upgrades to the service. Busways advised that bus services were continually under review and that more frequent services would be considered as additional residential development occurs in Gwandalan, Nords Wharf and Catherine Hill Bay. Table 3-14 summarises broader assessment of the proposal against the objectives of the Integrating Land Use and Transport policy (ILUT) package.

Table 3-14 ILUT objectives and compliance

ID	ILUT objectives	Compliance
1	Improving access to housing, jobs and services by walking, cycling and public transport	A pedestrian and cycleway network will be provided to facilitate the movement of pedestrians and cyclist through the development area. Within the development proposal, the street network will be designed to provide safe walking routes and bicycle routes that link the site with the existing services and facilities in Middle Camp and Catherine Hill Bay. Due to low volume of traffic on local roads, it is expected that cyclist demand could be catered for on –road. The shared use paths provide an incentive for residents to choose cycling as their transport mode, for work or other purposes such as school or recreation. Through the NSW Government's Bike Plan, the Government will work in partnership with local councils communities and business to encourage bike riding growth and safer cycling in New South Wales.
2	Increasing the choice of available transport and reducing dependence on cars;	The concept plan for Middle Camp proposal will create an environment that is friendly to pedestrians, cyclists and public transport users, including elderly people and people with disabilities. A pedestrian network will be installed to provide for movements of pedestrians throughout the development area. The local roads within the development will be designed to provide safe walking and bicycle routes that link with the foreshore, its park and other existing services and facilities in Catherine Hill Bay. Due to low volume of traffic on local roads, it is expected that cyclist demand could be catered for on –road.
3	Reducing travel demand including the number of trips generated by development and the distances travelled, especially by car	Pedestrian and cycle routes within the development will connect with existing facilities provided along Flowers Drive including existing public transport services.

ID	ILUT objectives	Compliance
4	Supporting the efficient and viable operation of public transport services	The existing bus service (Route 99) that runs along the Flowers Drive would be able to service the additional demand from this site. Bus stops located along the Flowers Drive would serve the majority of residential development within a 400 metres walk catchment. Due to the proposed left in/left out arrangement at Flowers Drive/Pacific Highway intersection, existing bus service (route 99) along the Flowers Drive will be affected. Discussion will be held with the bus operator and road network will be designed for a bus service.
5	Providing for the efficient movement of freight	Not applicable for Middle Camp site.

4 Summary of findings

This traffic report was prepared to examine the impact on road network from 222 residential dwellings at Catherine Hill Bay (Middle Camp) site. In assessing the traffic impact Hyder considered the broader traffic assumptions, and the implications of the additional development traffic on the Pacific Highway intersections performances based on the cumulative impact. Key findings from the investigation are as follows:

- Access to Catherine Hill Bay is generally available via the Flowers Drive and Montefiore Street, which provide access to the Pacific Highway from the north and south respectively.

- Journey to Work data indicates that journeys to and from work for Catherine Hill Bay residents was predominantly by private car (94%) with Lake Macquarie, Wyong and Newcastle LGAs the principal destinations. Travel by public transport amounted to a further 3% of trips, while other modes such as walking or cycling constituted the remaining 3% of trips. Approximately 3% of journeys to work used public transport and, the Catherine Hill Bay development may provide opportunities to increase bus services to meet additional demand.

- Recent crash data indicates that the majority of crashes around Catherine Hill Bay occurred on the Pacific Highway. Between 2004 and 2010, about 146 crashes occurred on the Pacific Highway. Of that 3 fatal crashes were recorded on the Pacific Highway. About 7 crashes were recorded along the Flowers Drive. We anticipate that additional traffic generated by a development at Middle Camp is unlikely to have any significant impact on the number or severity of crashes in the vicinity of Catherine Hill Bay.

- Recent traffic counts data indicates most traffic travels to Catherine Hill Bay via Flowers Drive and Montefiore Street. Flowers Drive and Montefiore Street carried approximately 700 and 500 vehicles per day respectively (based on average five weekdays data). Traffic data suggests right turn movement out of Flowers Drive experience longer delays at Pacific Highway/Cams Wharf Road/ Flowers Drive intersection.

  The traffic generation from Middle Camp development will be in the order of 189 peak one hour and 2,000 daily vehicle movements. The additional traffic generated by the Middle Camp development in conjunction with expected cumulative growth from other proposed development in Catherine Hill Bay will impact the performance of Pacific Highway/Cams Wharf Road/ Flowers Drive and Pacific Highway/ Montefiore Street intersections.The development at Middle Camp will generate about 189 peak hour two way trips. The critical movement at Pacific Highway/Flowers Drive is predicted as a high degree of saturation (DoS) value and operate with low level of service (LoS F). The traffic analysis confirmed that Pacific Highway/Flowers Drive intersection would require upgrading with 222 dwellings at Middle Camp.

- For cumulative traffic growth, the analysis suggested that proposed upgrades with the Pacific Highway comprising the following modifications would be required:

  - Cams Wharf Road/ Flowers Drive: maintain right turn from Pacific Highway to Cams Wharf Road. Ban right turn from Cams Wharf Road to Pacific Highway. Flowers Drive traffic will be restricted to left in/left out only.

- Montefiore Street: provide a seagull intersection with full access to Montefiore Street and traffic signal control on the Pacific Highway southbound and Montefiore Street.

- With the proposed development, Flowers Drive through Middle Camp is forecast to carry about 220 vehicles in one peak hour and 2,130 vehicles per day. The post development traffic on Flowers Drive will be less than the environmental goals for residential streets set out by the RTA.
- In the event that the proposed Rose Group development at Catherine Hill Bay does not proceed, the traffic analysis has determined low impact at Pacific Highway/Montefiore Street intersection. The traffic modelling result has identified no upgrading requirements of the Pacific Highway/Montefiore Street intersection deriving from existing traffic and the Coal & Allied development at Middle Camp.

4.1 Director General's requirements

Table 4-1 Director General's Requirements

DG Requirement	Relevant Report Chapter(s)
(1) Prepare a Traffic Study in accordance with RTA's *Guide Traffic Generating Developments* that includes (but is not limited to) the following:	
a) An identification of all relevant vehicular traffic routes and intersection for access to/from the area;	Chap.2 Chap 3.4
b) Current traffic counts for all of the above traffic routes and intersections;	Chap.2 Chap. 2.8
c) The anticipated vehicular traffic generated from the proposed development and associated trip distribution on the road network;	Chap.3 Chap 3.1
d) Consideration of the traffic impact on the existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated;	Chap.3.3
e) An analysis of the cumulative traffic and transport impacts of the development taking into consideration other proposed developments;	Chap.3.3
f) Details of necessary road network infrastructure upgrades required to maintain existing levels of service both on the local and classified road network;	Chap.3.5
g) An intersection analysis, using SIDRA or similar traffic model, as well as a micro simulation model to determine the need for intersection and mid block capacity upgrades and to ensure traffic signal coordination;	Chap.3.3 Chap 3.5
h) Proposed pedestrian and cycleway access within and to the site that connects to all relevant transport services, nearby settlements, and other key off-site locations having regard to the *NSW Planning Guidelines for Walking and Cycling* (2004), and the *NSW Bike Plan* (2010);	Chap.3.9
i) Timing of delivery of proposed transport infrastructure including road and intersection upgrades, pedestrian and cycle paths, and public transport infrastructure; and	Chap 3.8

j) Consideration of impacts on existing property access.	Chap 3.6
(2) Assess the proposal against the objectives of the Integrating Land Use and Transport policy package.	Chap 3.9

Appendix A

Travel time and traffic distribution data on Flowers Drive

A-1 Travel time assumptions and hourly traffic distribution

Route Attractiveness between Flowers Dr and Montefiore St

Route ID	Route (between 1 and 2)	Distance (km)	Without LATM through Middle Camp		With LATM through Middle Camp	
			Travel time (min)	Average speed (kph)	Travel time (min)	Average speed (kph)
R1	via Pacific Hwy / Montefiore St	6.3	4.3	88	4.3	88
R2	via Flowers Dr / Middle Camp	3.6	4.0	54	4.2	51

Note: travel time includes delay at intersection and side effects of local road (e.g. crossing, on-street parking, unparking maneuver)

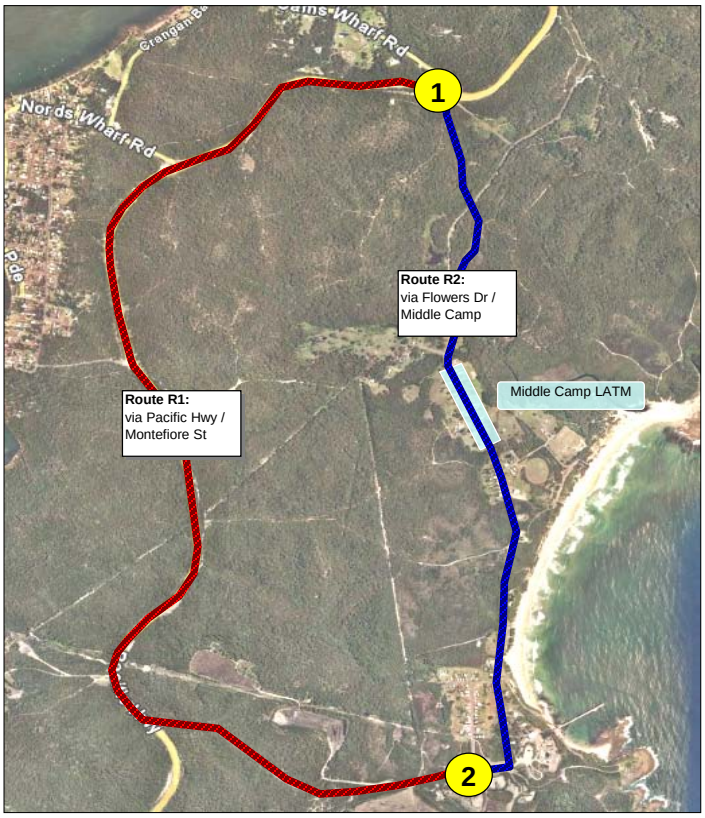


Figure A-1 route attractiveness between Flowers Drive and Montefiore Street

Sources: Proposed Moonee Hamlets Development, Catherine Hill Bay. Transport Report, MWT; Hyder's travel time estimate.

Traffic Forecasts on Flowers Drive with LATM in place

Traffic Forecasts on Flowers Drive (through Middle Camp)		
Hour	**2007 Existing Traffic**	**2012 Forecast Traffic**
	Average 7 Days	**Average 7 Days**
0-1	2	4
1-2	1	2
2-3	1	2
3-4	2	3
4-5	1	2
5-6	7	12
6-7	22	40
7-8	39	72
8-9	47	147
9-10	56	152
10-11	71	140
11-12	70	139
12-13	77	142
13-14	86	147
14-15	73	144
15-16	80	136
16-17	74	120
17-18	50	66
18-19	22	31
19-20	18	23
20-21	10	13
21-22	12	19
22-23	7	9
23-24	4	8
Daily	**831**	**1575**

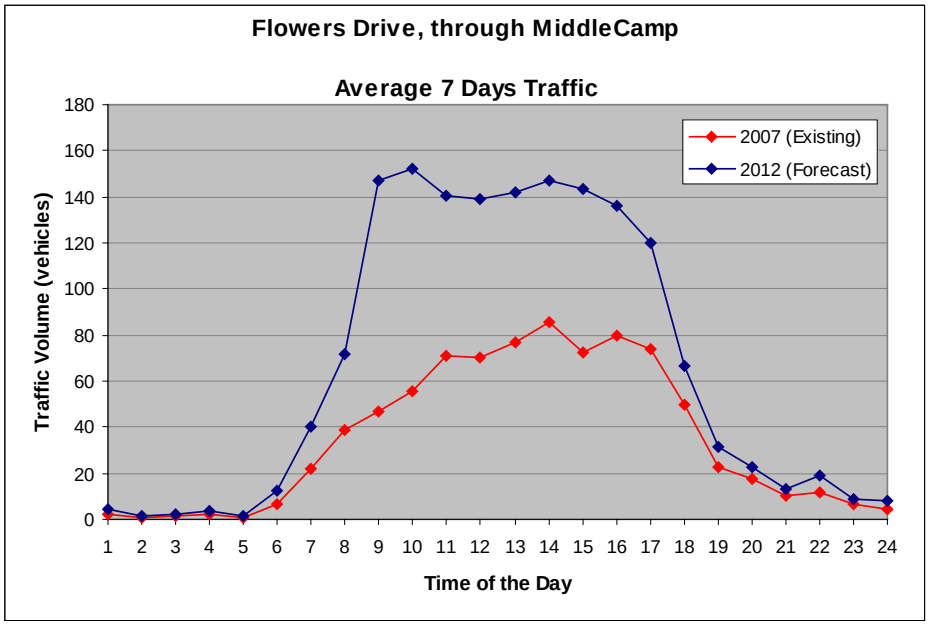


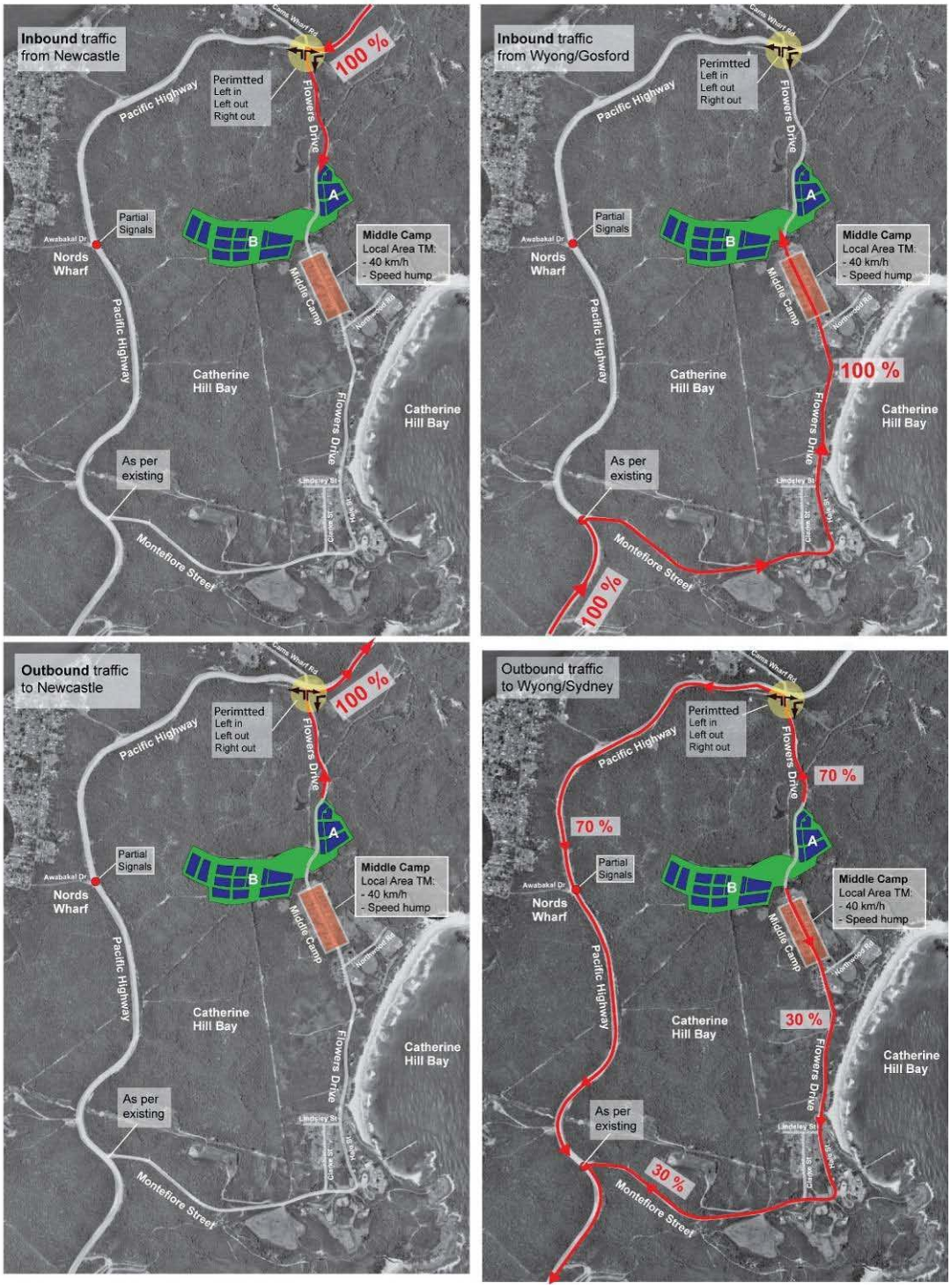
Figure A-2 Traffic Forecasts on Flowers Drive with LATM in place

Appendix B

Traffic distribution assumptions for access Option 1 and access Option 2 (without out Rose Group site at Catherine Hill Bay)

Coal & Allied, Middle Camp Site

Access assumptions without Rose Group development
(Coal & Allied Middle Camp development site alone)
Option 1



Coal & Allied, Middle Camp Site

Access assumptions without Rose Group development
(Coal & Allied Middle Camp development site alone)
Option 2